GEOLOGICAL AND ENVIRONMENTAL SCIENCES

https://liberalarts.pacific.edu/liberalarts/academics/departments-and-programs/geological-and-environmental-sciences/progr
Phone: (209) 946-2482
Location: Geosciences Center, South Campus
Dr. Lydia K. Fox, Chair

Degrees Offered

Bachelor of Arts
Bachelor of Science

Majors Offered

Geological & Environmental Sciences (BS)

- **Environmental Science concentration**
- **Geology concentration**

Geological & Environmental Sciences with Departmental Honors (BS)

- **Environmental Science concentration**
- **Geology concentration**

Geological & Environmental Sciences (BA)
Geological & Environmental Sciences and Law - Environmental Law Advantage Program (BA+JD)
Geological & Environmental Sciences with Departmental Honors (BA)

Minors Offered

Environmental Science
Geology

The **Bachelor of Science in Geological and Environmental Sciences** prepares students for professional employment or graduate study in geology or environmental science. Students earning a BS in Geological and Environmental Sciences are competitive for jobs in a number of fields, including geotechnical and environmental consulting, where they assess geologic hazards and environmental impacts, government agencies at the state and federal level, as well as in natural resource management. An increasing emphasis on environmental issues and growing demand for natural resources, in addition to recent retirement patterns in the Geological and Environmental Sciences, create a considerable demand for these well-trained scientists. According to the American Geological Institute, Masters and PhD-level geoscientists have experienced effectively zero unemployment during the past 20 years.

Environmental Science Concentration
Environmental Science majors use an interdisciplinary approach to the natural sciences, integrating a core of geology, biology, chemistry, and mathematics with policy and humanities classes. This degree prepares students for exciting careers in science-based fields, such as pollution abatement, ecosystem protection, environmental restoration, as well as newly emerging fields in science communications and the technology industry.

Geology Concentration
Geology degrees are built on a foundation in the natural and physical sciences and integrate physics, chemistry, mathematics and a variety of advanced geology courses. This preparation provides the tools needed to scientifically approach all aspects of the earth system. Geology degrees are extremely marketable and prepare students for competitive careers in a broad range of traditional (geotechnical and environmental consulting, energy exploration, land use and resource management, natural hazard assessment) and non-traditional (law, policy, business, communication, education) fields.

The **Bachelor of Arts in Geological and Environmental Sciences - Environmental Law Advantage** program allows students interested in a career in law to complete both an undergraduate degree and a law degree in six years (rather than the typical seven years). Earning a degree in a scientific field sets students apart from their peers when they apply for and enroll in law school by providing them with the technical understanding of Earth systems and processes that is essential for understanding the impact of legal arguments and case histories. Pacific's McGeorge School of Law (https://law.pacific.edu/law/) is an ideal place to explore these connects, as their faculty (https://law.pacific.edu/law/faculty/) have extensive expertise in local to global scale environmental problems. Indeed, McGeorge uses the extensive expertise to support offering a Water & Environmental Certificate of Concentration (https://law.pacific.edu/law/water-and-environmental-law-certificate-of-concentration/). In this program, students will earn a Bachelor of Arts (BA) in Geological and Environmental Sciences and a Juris Doctor (JD) law degree in a total of 6 years. Although students will be well prepared for an environmental law career, the LAW program enables students to practice in any area of law.

Note: *Students must fulfill all the criteria for admissions into McGeorge including completion of the McGeorge JD admissions application submitted through the Law School Admissions Council in Spring semester of the junior year. Admission to McGeorge School of Law requires an LSAT score of 153 and a minimum University of the Pacific cumulative grade point average of 3.3 (as calculated by LSAC).*

The **Bachelor of Arts in Geological and Environmental Sciences** is for liberal arts students with a strong interest in the earth and its environments, but who may wish to couple their major with multiple other programs or pursue a career outside the sciences, such as in policy, communications, advocacy. The breadth of a BA in Geological and Environmental Sciences is ideal for preparing students for professional degrees and successful careers in law, education, business, administration, or international relations.

The Department of Geological and Environmental Sciences

In the Department of Geological and Environmental Sciences we take a broad view of the Earth and offer courses that develop the practice of scientific inquiry and an understanding of our planet, its history, natural systems, resources and recent global change. Our students explore the origin of the Earth and solar system, the formation of continents and oceans, the evolution and extinction of life, the distribution and availability of water and natural resources, and the impact of humans on ecosystems and the environment. A truly distinctive and critical component of the student experience in our department is our experiential-based education that includes laboratory and field work and is designed to inspire in our students a lifelong passion for learning about the natural world. Many of our majors work closely with faculty on award-winning collaborative research projects that advance scientific knowledge of the Earth and its environments or participate in internship experiences throughout the United States.

Systems & Cycles
Understand fundamental environmental systems, cycles, processes, and interactions between and among them.

Materials
Identify common earth materials in the lab and the field and interpret their origin.

Problem Solving
Acquire and apply knowledge from the liberal arts to address problems.

Standardized Approach
Employ consistently the standardized approach ("scientific method") in research and problem solving.

Oral Communication
Communicate science effectively in oral form and with a style appropriate to a range of audiences.

Written Communication
Communicate science effectively in written form and with a style appropriate to a range of audiences.

Professionalism
Demonstrate professionalism in interactions, collaboration, and approaches to ethical dilemmas in the discipline.

Bachelor of Arts Major in Geological and Environmental Sciences

Students must complete a minimum of 120 units with a cumulative and major/program grade point average of 2.0 in order to earn the bachelor of arts degree with a major in geological and environmental science.

I. General Education Requirements

For more details, see General Education (http://catalog.pacific.edu/stocktongeneral/generaleducationprogram/)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

CORE 001	Problem Solving & Oral Comm	3
CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. ***2)*** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

- Artistic Process & Creation
- Civic & Global Responsibility
- Language & Narratives
- Quantitative Reasoning
- Scientific Inquiry
- Social Inquiry
- World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

- Writing
- Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. College of the Pacific BA Requirement

The student must complete one year of college instruction or equivalent training in a language other than English.

Note: 1) *Transfer students with sophomore standing are exempt from this requirement.*

III. Breadth Requirement

The student must complete 60 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

IV. Major Requirements

GESC 102	Introduction to Geographic Information Systems (GIS) and Spatial Analysis	
GESC 103	Earth's Changing Climate	
GESC 106	Earth Materials	
GESC 148	Critical Zone Science	
GESC 185	Capstone Seminar in Geological and Environmental Sciences	
GESC 195	Professional Development Seminar **	
Select one of the following:		4
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 061	Geology of California	
GESC 065	Regional Geology	
Select one of the following:		4
BIOL 035	Environment: Concepts and Issues	
GESC 043	Environmental Science for Informed Citizens	
GESC 047	Introduction to Oceanography	
Select two of the following GECS or BIOL electives: *		8-9
BIOL 072	Vertebrate Biology	
BIOL 074	Biology of Insects	
BIOL 076	Marine Biology	
BIOL 077	Marine Birds and Mammals	
BIOL 079	California Flora	
BIOL 171	Methods in Field Biology	
BIOL 175	Ecology	
GESC 110	Igneous and Metamorphic Petrology	
GESC 112	Sedimentology and Stratigraphy	
GESC 114	Structural Geology	
GESC 142	Geochemistry	
GESC 161	Geologic Field Methods	
Select one of the following:		4
MATH 035	Elementary Statistical Inference	

MATH 037	Introduction to Statistics and Probability	
Select one of the following:		4
CHEM 023	Elements of Chemistry	
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	
Select one of the following:		4
CIVL 171	Water and Environmental Policy	
ECON 157	Environmental and Natural Resource Economics	
POLS 174	Global Environmental Policy	

* Electives should be selected in consultation with your advisor.

** Must be taken each semester of Junior and Senior year to a maximum of 4 times.

Bachelor of Arts Major in Geological and Environmental Sciences with Departmental Honors

Students must complete a minimum of 120 units with a cumulative grade point average of 3.5 and major/program grade point average of 3.3 in order to earn the bachelor of arts degree with a major in geological and environmental science with departmental honors.

I. General Education Requirements

For more details, see General Education (http://catalog.pacific.edu/stocktongeneral/generaleducationprogram/)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

CORE 001	Problem Solving & Oral Comm	3
CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. ***2)*** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

Artistic Process & Creation
Civic & Global Responsibility
Language & Narratives
Quantitative Reasoning
Scientific Inquiry
Social Inquiry
World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

Writing
Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. College of the Pacific BA Requirement

The student must complete one year of college instruction or equivalent training in a language other than English.

Note: 1) *Transfer students with sophomore standing are exempt from this requirement.*

III. Breadth Requirement

The student must complete 60 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

IV. Major Requirements

GESC 102	Introduction to Geographic Information Systems (GIS) and Spatial Analysis	
GESC 103	Earth's Changing Climate	
GESC 106	Earth Materials	
GESC 148	Critical Zone Science	
GESC 185	Capstone Seminar in Geological and Environmental Sciences **	
GESC 195	Professional Development Seminar ****	
GESC 197	Undergraduate Research ***	
Select one of the following:		4
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 061	Geology of California	
GESC 065	Regional Geology	
Select one of the following:		4
BIOL 035	Environment: Concepts and Issues	
GESC 043	Environmental Science for Informed Citizens	
GESC 047	Introduction to Oceanography	
Select two of the following GECS or BIOL electives: *		8-9
BIOL 072	Vertebrate Biology	
BIOL 074	Biology of Insects	
BIOL 076	Marine Biology	
BIOL 077	Marine Birds and Mammals	
BIOL 079	California Flora	
BIOL 171	Methods in Field Biology	
BIOL 175	Ecology	
GESC 110	Igneous and Metamorphic Petrology	
GESC 112	Sedimentology and Stratigraphy	
GESC 114	Structural Geology	
GESC 142	Geochemistry	
GESC 161	Geologic Field Methods	
Select one of the following:		4
MATH 035	Elementary Statistical Inference	
MATH 037	Introduction to Statistics and Probability	

Select one of the following:		4
CHEM 023	Elements of Chemistry	
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	
Select one of the following:		4
CIVL 171	Water and Environmental Policy	
ECON 157	Environmental and Natural Resource Economics	
POLS 174	Global Environmental Policy	

* Electives should be selected in consultation with your advisor.

** Prepare a thesis, a national conference presentation, a manuscript for publication, or an extended GESC 185 paper. Student must present the results in a GESC seminar.

*** Students must complete at least two semesters of GESC 197 under the direction of their chosen faculty member.

**** Must be taken each semester of Junior and Senior year to a maximum of 4 times.

Bachelor of Science Major in Geological and Environmental Sciences

Students must complete a minimum of 120 units with a cumulative and major/program grade point average of 2.0 in order to earn the bachelor of science degree with a major in geological and environmental science.

I. General Education Requirements

For more details, see General Education (http://catalog.pacific.edu/stocktongeneral/generaleducationprogram/)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

CORE 001	Problem Solving & Oral Comm	3
CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. ***2)*** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

Artistic Process & Creation
Civic & Global Responsibility
Language & Narratives
Quantitative Reasoning
Scientific Inquiry
Social Inquiry
World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

Writing
Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. Breadth Requirement

Students must complete 60 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

III. Major Requirements

Students must complete the core courses and also select from one of the tracks below.

Core		
GESC 102	Introduction to Geographic Information Systems (GIS) and Spatial Analysis	
GESC 103	Earth's Changing Climate	
GESC 106	Earth Materials	
GESC 148	Critical Zone Science	
MATH 037	Introduction to Statistics and Probability	
MATH 051	Calculus I	
GESC 185	Capstone Seminar in Geological and Environmental Sciences	
GESC 195	Professional Development Seminar **	
Select one of the following:		4-5
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	
Select one of the following:		4
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 061	Geology of California	
GESC 065	Regional Geology	
Select one of the following:		4
BIOL 035	Environment: Concepts and Issues	
GESC 043	Environmental Science for Informed Citizens	
GESC 047	Introduction to Oceanography	
Select one of the following:		4
CIVL 171	Water and Environmental Policy	
ECON 157	Environmental and Natural Resource Economics	
POLS 174	Global Environmental Policy	
Geology Concentration		
GESC 110	Igneous and Metamorphic Petrology	
GESC 112	Sedimentology and Stratigraphy	
GESC 114	Structural Geology	
GESC 142	Geochemistry	
GESC 161	Geologic Field Methods	
Select one of the following: *		4
GESC 187	Internship in Geosciences	
GESC 197	Undergraduate Research	
Select one of the following:		5

PHYS 023	General Physics I	
PHYS 053	Principles of Physics I	
Select one of the following:		5
PHYS 025	General Physics II	
PHYS 055	Principles of Physics II	
Environmental Science Concentration		
BIOL 051	Principles of Biology	
BIOL 061	Principles of Biology	
BIOL 171	Methods in Field Biology	
CIVL 060	Water Quality	
BIOL 175	Ecology	
Select one of the following:		4
BIOL 072	Vertebrate Biology	
BIOL 074	Biology of Insects	
BIOL 076	Marine Biology	
BIOL 077	Marine Birds and Mammals	
BIOL 079	California Flora	
Select one of the following:		4
ENGL 126	Environmental Health and Literature	
HIST 052	John Muir and the Environmental Movement	
HIST 136	American Environmental History	
SOCI 111	Environmental Health & Justice	
PHIL 035	Environmental Ethics	
Select one of the following:		4
BIOL 197	Undergraduate Research	
GESC 187	Internship in Geosciences	
GESC 197	Undergraduate Research	

* Students can also complete a Geologic field camp.

** Must be taken each semester of Junior and Senior year to a maximum of 4 times.

Bachelor of Science Major in Geological and Environmental Sciences with Departmental Honors

Students must complete a minimum of 120 units with a cumulative grade point average of 3.5 and major/program grade point average of 3.3 in order to earn the bachelor of science degree with a major in geological and environmental science with departmental honors.

I. General Education Requirements

For more details, see General Education (http://catalog.pacific.edu/stocktongeneral/generaleducationprogram/)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

CORE 001	Problem Solving & Oral Comm	3
CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. ***2)*** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

Artistic Process & Creation
Civic & Global Responsibility
Language & Narratives
Quantitative Reasoning
Scientific Inquiry
Social Inquiry
World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

Writing
Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. Breadth Requirement

Students must complete 60 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

III. Major Requirements

Students must complete the core courses and also select from one of the tracks below.

Core		
GESC 102	Introduction to Geographic Information Systems (GIS) and Spatial Analysis	
GESC 103	Earth's Changing Climate	
GESC 106	Earth Materials	
GESC 148	Critical Zone Science	
MATH 037	Introduction to Statistics and Probability	
MATH 051	Calculus I	
GESC 185	Capstone Seminar in Geological and Environmental Sciences *	
GESC 195	Professional Development Seminar ***	
Select one of the following:		4-5
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	
Select one of the following:		4
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 061	Geology of California	
GESC 065	Regional Geology	
Select one of the following:		4
BIOL 035	Environment: Concepts and Issues	
GESC 043	Environmental Science for Informed Citizens	

GESC 047	Introduction to Oceanography	
Select one of the following:		4
CIVL 171	Water and Environmental Policy	
ECON 157	Environmental and Natural Resource Economics	
POLS 174	Global Environmental Policy	
Geology Concentration		
GESC 110	Igneous and Metamorphic Petrology	
GESC 112	Sedimentology and Stratigraphy	
GESC 114	Structural Geology	
GESC 142	Geochemistry	
GESC 161	Geologic Field Methods	
Select one of the following: **		4
GESC 187	Internship in Geosciences	
GESC 197	Undergraduate Research	
Select one of the following:		5
PHYS 023	General Physics I	
PHYS 053	Principles of Physics I	
Select one of the following:		5
PHYS 025	General Physics II	
PHYS 055	Principles of Physics II	
Environmental Science Concentration		
BIOL 051	Principles of Biology	
BIOL 061	Principles of Biology	
BIOL 171	Methods in Field Biology	
CIVL 060	Water Quality	
BIOL 175	Ecology	
Select one of the following:		4
BIOL 072	Vertebrate Biology	
BIOL 074	Biology of Insects	
BIOL 076	Marine Biology	
BIOL 077	Marine Birds and Mammals	
BIOL 079	California Flora	
Select one of the following:		4
ENGL 126	Environmental Health and Literature	
HIST 052	John Muir and the Environmental Movement	
HIST 136	American Environmental History	
SOCI 111	Environmental Health & Justice	
PHIL 035	Environmental Ethics	
Select one of the following: **		4
BIOL 197	Undergraduate Research	
GESC 187	Internship in Geosciences	
GESC 197	Undergraduate Research	

* Prepare a thesis, a national conference presentation, a manuscript for publication, or and extended GESC 185 paper. Student must present the results in a GESC seminar.

** Students must complete at least two semesters of GESC 197 under the direction of their chosen faculty member.

*** Must be taken each semester of Junior and Senior year to a maximum of 4 times.

Bachelor of Arts Major in Geological and Environmental Sciences and Law

Students must complete a minimum of 120 units with a cumulative and major/program grade point average of 2.0 in order to earn the bachelor of arts degree with a major in geological and environmental sciences and law.

I. General Education Requirements

For more details, see General Education (http://catalog.pacific.edu/stocktongeneral/generaleducationprogram/)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

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CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. ***2)*** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

Artistic Process & Creation
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Language & Narratives
Quantitative Reasoning
Scientific Inquiry
Social Inquiry
World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

Writing
Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. College of the Pacific BA Requirement

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Note: 1) *Transfer students with sophomore standing are exempt from this requirement.*

III. Breadth Requirement

The student must complete 60 units outside the primary discipline of the first major, regardless of the department who offers the course(s) in that

discipline. (This includes general education courses, transfer courses, CPCE/EXTN units, internships, etc.)

IV. Major Requirements

GESC 102	Introduction to Geographic Information Systems (GIS) and Spatial Analysis	
GESC 103	Earth's Changing Climate	
GESC 106	Earth Materials	
GESC 148	Critical Zone Science	
GESC 185	Capstone Seminar in Geological and Environmental Sciences	
GESC 195	Professional Development Seminar **	
Select one of the following:		4
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 061	Geology of California	
GESC 065	Regional Geology	
Select one of the following:		4
BIOL 035	Environment: Concepts and Issues	
GESC 043	Environmental Science for Informed Citizens	
GESC 047	Introduction to Oceanography	
Select two of the following GESC or BIOL electives: *		8-9
BIOL 072	Vertebrate Biology	
BIOL 074	Biology of Insects	
BIOL 076	Marine Biology	
BIOL 077	Marine Birds and Mammals	
BIOL 079	California Flora	
BIOL 171	Methods in Field Biology	
BIOL 175	Ecology	
GESC 110	Igneous and Metamorphic Petrology	
GESC 112	Sedimentology and Stratigraphy	
GESC 114	Structural Geology	
GESC 142	Geochemistry	
GESC 161	Geologic Field Methods	
Select one of the following:		4
MATH 035	Elementary Statistical Inference	
MATH 037	Introduction to Statistics and Probability	
Select one of the following:		4
CHEM 023	Elements of Chemistry	
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	
Select one of the following:		4
CIVL 171	Water and Environmental Policy	
ECON 157	Environmental and Natural Resource Economics	
POLS 174	Global Environmental Policy	

* Electives should be selected in consultation with your advisor.

** Must be taken each semester of Junior and Senior year to a maximum of 4 times.

V. Awarding the Bachelor of Arts degree

After successful completion of all the requirements listed above and successful completion of 22 units in the McGeorge School of Law JD program, students will be awarded a Bachelor of Arts in Geological and Environmental Sciences and Law.

VI. JD Requirements

The full requirements for a McGeorge Juris Doctorate are listed in their catalog. Students should refer to the specific degree requirements for their graduating class to ensure they are on track.

Minor in Environmental Science

Students must complete a minimum of 20 units with a Pacific minor grade point average of 2.0 in order to earn a minor in environmental science.

Minor Requirements:

Select one of the following:		5-10
BIOL 041	Introduction to Biology	
BIOL 051 & BIOL 061	Principles of Biology and Principles of Biology	
Select one of the following:		5
BIOL 175	Ecology	
BIOL 176	Ecology and Conservation Biology	
Select one of the following:		4
GESC 043	Environmental Science for Informed Citizens	
GESC 047	Introduction to Oceanography	
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 061	Geology of California	
GESC 065	Regional Geology	
Select three courses in consultation with advisor *		12-15

* At least two courses must be GESC 100 or above, excluding GESC 105.

Minor in Geology

Students must complete a minimum of 20 units with a Pacific minor grade point average of 2.0 in order to earn a minor in geology.

Minor Requirements:

Select one of the following:		4-5
GESC 051	Dynamic Planet	
GESC 053	Earth and Life Through Time	
GESC 057	Earth Systems Science	
GESC 061	Geology of California	
GESC 065	Regional Geology	
GESC Electives (4 additional courses GESC 100 and above excluding GESC 105)		16

Geo and Enviro Sciences Courses

GESC 010. First Year Seminar in GESC. 1 Unit.

This course provides freshmen with some essential skills for success in GESC majors at Pacific. Topics include study and time management skills, research and internships opportunities, and career planning. Along the way, freshmen are introduced to department faculty, staff, librarians, and their fellow students.

GESC 020. Living on Planet Earth. 1 Unit.
This course is a concurrent seminar and field work course for participants in the Residence for Earth and Environmental Living and Learning Community (REELL). Students investigate their impact on Earth and the Environment within the context of guest lectures, discussions, and activities related to global environmental change, carbon footprints, management of natural resources, and sustainability. Prerequisite: Concurrent enrollment in the REELL community or permission of the instructor.

GESC 041. Environmental Geology. 4 Units.
This lecture and field work course studies the interaction between humans and the physical environment as well as analyzes the physical constraints placed on human activities by geological processes and the effects that human activities have on the environment.

GESC 043. Environmental Science for Informed Citizens. 4 Units.
This interdisciplinary course of lecture, laboratory, and field work focus on the analysis of policy-relevant environmental problems in four domains: water, energy, climate and land use - with an emphasis on human interactions. **(GE3A, GESI)**

GESC 044. Introduction to Sustainability. 4 Units.
This course will introduce you to the essential elements of sustainability. We will explore topics such as climate change, renewable energy, water conservation, agriculture, waste, green building, socially responsible business, ecosystem valuation, microlending, environmental justice, and alternative progress indicators, among others. We will investigate approaches to creating a sustainable future that foster environmental resilience, social equity, and economic growth. **(GEGR)**

GESC 047. Introduction to Oceanography. 4 Units.
An introduction to the geological, chemical, physical, and biological aspects of the Earth's ocean. This lecture and laboratory class introduces students to plate tectonics, physiography of ocean basins and continental margins, ocean sediment, atmosphere and ocean circulation, waves and tides, coasts, and marine ecology. Laboratory applications include problem-solving in oceanography, including related aspects of geology, physics, chemistry and biology of the ocean. **(GE3A, GESI)**

GESC 051. Dynamic Planet. 4 Units.
This course is an introduction to the fundamental concepts of geology and geological reasoning. Concepts covered include: the nature and origin of earth materials, the processes and forces which create and shape the surface of the earth and affect its internal structure within the context of deep time, as well as a study of earth resources and human interactions with the environment. The course includes laboratory and field work. Credit for this course is not given if a student has credit for GEOS 061, GESC 061, GEOS 065 or GESC 065. **(GE3A, GESI)**

GESC 053. Earth and Life Through Time. 4 Units.
This lecture, laboratory, and field study class introduces students to the geologic history of the earth as interpreted through analysis of the stratigraphic and fossil record, structural relationships and isotopic dating techniques. Particular emphasis is placed on the geologic evolution of North America. **(GE3A, GESI)**

GESC 057. Earth Systems Science. 4 Units.
This lecture, laboratory, and field study class introduces the study of the Earth using a systems approach. The focus is on the subsystems (geosphere, hydrosphere, atmosphere, biosphere) and the dynamic interactions between them. The approach develops an understanding of the balance that exists in the global environment as a result of the processes within and interactions between the systems. **(GE3A, GESI)**

GESC 061. Geology of California. 4 Units.
This course is a lecture, laboratory, and field-based introduction to the fundamental principles of geology and geological reasoning that are reinforced during a four-day camping trip. The course involves a scientific study of the planet Earth, including earth systems, earth materials, the physical processes shaping the earth, and the history of the earth and its life forms within the context of deep time. The geologic implications of human activities on the environment, earth resources and climate change are also studied. Credit for this course is not given if a student has credit for GEOS 051, GESC 051, GEOS 065 or GESC 065. **(GE3A, GESI)**

GESC 065. Regional Geology. 4 Units.
This is a field intensive study of a geologically relevant area including investigations of plate tectonics, a formation of rocks and minerals, the hydrologic cycle, formation of landforms, geologic time, and climate change. Possible study regions include Hawaii, the Colorado Plateau, Chile, Costa Rica, and Alaska. This course includes laboratory work and a multi-day field trip during spring break. Credit for this course is not given if a student has credit for GEOS 051, GESC 051, GEOS 061 or GESC 061. **(GE3A, GESI)**

GESC 093. Special Topics. 4 Units.
Special Topics. **(GEGR)**

GESC 102. Introduction to Geographic Information Systems (GIS) and Spatial Analysis. 4 Units.
A geographic information system (GIS) provides a framework for storage, retrieval, analysis, and visualization of geographically referenced (ie., spatial) data. Because GIS techniques allow one to spatially represent social and environmental data, GIS has become an important tool across a variety of fields including planning, engineering, public health, environmental science, epidemiology, and business. Further, GIS has become an important political instrument allowing communities and regions to (geo)graphically tell their stories. This course emphasizes both skill building in GIS tools and techniques and hypothesis testing through the analysis of spatial relationships, patterns, and processes. Ultimately, you will learn to use GIS as tool for analyzing data and telling the stories of “place”. Laboratory exercises and projects in this class focus on applications of GIS for understanding and managing the interactions between people and their environment.

GESC 103. Earth's Changing Climate. 4 Units.
This lecture and laboratory interdisciplinary study of the Earth’s dramatic and abrupt changes in the past and their tremendous environmental repercussions has an emphasis on human interactions and future changes. Prerequisites: GESC 043,GESC 044,GESC 047,GESC 051,GESC 053,GESC 057,GESC 061,GESC 065,S

GESC 105. Field Studies. 1 or 2 Unit.
This field study of geological phenomena in western North America involves a minimum of three continuous days on a department-supervised field trip. Students can repeat this course for up to 4 units of credit. Prerequisite: an introductory GESC course and permission of instructor.

GESC 106. Earth Materials. 5 Units.
This lecture, laboratory, and field work course studies the origin occurrence, and identification of rock-forming minerals and the rocks they are found in. The focus is on crystallography and chemical and physical properties of rock-forming minerals and the major rock-forming processes. Prerequisites: an introductory GESC course (GESC 051 or GESC 053 or GESC 061) and a college level course in chemistry (CHEM 023 or CHEM 024 or CHEM 025 or CHEM 027) or instructor permission.

GESC 110. Igneous and Metamorphic Petrology. 4 Units.
This lecture, laboratory, and field work course characteristics, occurrence, origin and classification of igneous and metamorphic rocks with an emphasis on plate tectonic setting and the physical and chemical processes of the earth's interior. Methods include field study, hand specimen and thin section analysis. Prerequisite: GESC 106 or permission of instructor.

GESC 112. Sedimentology and Stratigraphy. 4 Units.
This lecture, laboratory, and field work course studies characteristics, occurrence, origins and 3-D relationships of sedimentary rocks, and the mineral resources they contain. The course focuses on the materials and processes of sedimentation, depositional environments, and the principles of stratigraphical analysis. Prerequisite, may be taken concurrently: GESC 106.

GESC 114. Structural Geology. 4 Units.
This lecture, laboratory, and required multi-day field trip course examines the character and causes of the geologic structures that deform Earth's crust within the context of whole-Earth structure, geotectonic processes and environments, and rock mechanics. Prerequisite: GESC 051 or permission of instructor.

GESC 120. Paleontology. 4 Units.
This lecture and laboratory course examines the study of the description, identification, uses, principles, interpretation and methods of study of major groups of fossils; invertebrate and vertebrate animals, plants and single-celled organisms. Prerequisite: GESC 053 or permission of instructor.

GESC 136. Petrography. 4 Units.
This lecture and laboratory course examines identification, classification, and interpretation of igneous, sedimentary, and metamorphic rocks using the petrographic microscope. Prerequisites: GESC 110 and GESC 112.

GESC 142. Geochemistry. 4 Units.
This lecture, laboratory, and field work course examines the application of chemical principles to the study of geological processes. Prerequisites: an introductory GESC course; CHEM 024 or CHEM 025 or CHEM 027; MATH 041.

GESC 144. Geomorphology. 4 Units.
This lecture, laboratory, and field work course studies the comprehensive treatment of the principles of landscape development, analysis of topographic maps and interpretation of aerial photographs. Prerequisite: an introductory GESC course.

GESC 148. Critical Zone Science. 4 Units.
The Critical Zone is the Earth's permeable near-surface layer…from the tops of the trees to the bottom of the groundwater. Despite the Critical Zone's importance to terrestrial life, it remains poorly understood. In this class, we will strive to understand the complex web of physical, chemical, and biological processes of the Critical Zone using a systems approach across a broad array of sciences: hydrology, geology, soil science, biology, ecology, geochemistry, geomorphology, and more. Course includes laboratory and field work. Prerequisites: GESC 043 or GESC 047 or GESC 053 or GESC 051 or GESC 061 or GESC 65; MATH 041 with a grade of "C" or better.

GESC 161. Geologic Field Methods. 4 Units.
This lecture and field study course introduces the basic methods and techniques of geologic field work, including measuring, describing, and interpreting stratigraphic sections and constructing geologic maps and cross sections. Particular emphasis is placed on the collection, analysis, and interpretation of geologic data; developing scientific writing and oral presentation skills; and the effective use of computer-generated graphics. The course involves one-day and multi-day field trips. Prerequisites: an introductory GESC course, GESC 110 and GESC 114 or permission of instructor.

GESC 185. Capstone Seminar in Geological and Environmental Sciences. 4 Units.
This seminar focuses on local/regional geological and environmental issues. Students investigate the background of local/regional geological/environmental issues and informed members of the community/region present their perspective on the issues. Students then work in teams to address scientific aspects of selected geological/environmental problems. Prerequisite: Senior standing in the major.

GESC 187. Internship in Geosciences. 1-4 Units.

GESC 191. Independent Study. 2-4 Units.

GESC 195. Professional Development Seminar. 0.5 Units.
A weekly seminar encompassing special topical lectures, professional development, and department citizenship activities for students majoring in programs within the Geological and Environmental Sciences Department. Prerequisite: Junior or senior standing.

GESC 197. Undergraduate Research. 1-4 Units.