SCHOOL OF EARTH, ENERGY AND ENVIRONMENTAL SCIENCES

The School of Earth, Energy and Environmental Sciences (formerly the School of Earth Sciences) lists courses under the subject code EARTH on the Stanford Bulletin's ExploreCourses web site (http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=EARTH&filter-catalognumber-EARTH=on). Courses offered by the School's departments and inter-departmental programs are linked on their separate sections, and are available at the ExploreCourses (http://explorecourses.stanford.edu/) web site.

The School of Earth, Energy and Environmental Sciences includes the departments of Geological Sciences, Geophysics, Energy Resources Engineering, and Earth System Science; and three interdisciplinary programs: the Earth Systems undergraduate B.S. and coterminal M.A. and M.S. programs, the Emmett Interdisciplinary Program in Environment and Resources (E-IPER) with Ph.D. and joint M.S, and the Sustainability and Science Practice Program with coterminal M.A. and M.S. programs.

The aims of the school and its programs are:

1. to prepare students for careers in the fields of agricultural science and policy, biogeochemistry, climate science, energy resource engineering, environmental science and policy, environmental communications, geology, geobiology, geochemistry, geomechanics, geophysics, geostatistics, sustainability science, hydrogeology, land science, oceanography, paleontology, petroleum engineering, and petroleum geology;
2. to conduct disciplinary and interdisciplinary research on a range of questions related to Earth, its resources and its environment;
3. to provide opportunities for Stanford undergraduate and graduate students to learn about the planet's history, to understand the energy and resource bases that support humanity, to address the geological and geophysical, and human-caused hazards that affect human societies, and to understand the challenges and develop solutions related to environment and sustainability.

To accomplish these objectives, the school offers a variety of programs adaptable to the needs of the individual student:

- four-year undergraduate programs leading to the degree of Bachelor of Science (B.S.)
- five-year programs leading to the coterminal Bachelor of Science and Master of Science (M.S.)
- five-year programs leading to the coterminal Bachelor of Science and Master of Arts (M.A.)
- graduate programs offering the degrees of Master of Science, Engineer, and Doctor of Philosophy.

Details of individual degree programs are found in the section for each department or program.

Undergraduate Programs in the School of Earth, Energy and Environmental Sciences

Any undergraduate admitted to the University may declare a major in one of the school's departments or the Earth Systems Program by contacting the appropriate department or program office.

Requirements for the B.S. degree are listed in each department or program section. Departmental academic advisers work with students to define a career or academic goal and assure that the student's curricular choices are appropriate to the pursuit of that goal. Advisers can help devise a sensible and enjoyable course of study that meets degree requirements and provides the student with opportunities to experience advanced courses, seminars, and research projects. To maximize such opportunities, students are encouraged to complete basic science and mathematics courses in high school or during their freshman year.

Coterminal Master's Degrees in the School of Earth, Energy and Environmental Sciences

The Stanford coterminal degree program enables an undergraduate to embark on an integrated program of study leading to the master's degree before requirements for the bachelor's degree have been completed. This may result in more expeditious progress towards the advanced degree than would otherwise be possible, making the program especially important to Earth scientists because the master's degree provides an excellent basis for entry into the profession. The coterminal plan permits students to apply for admission to a master's program after earning 120 units, completion of six non-summer quarters, and declaration of an undergraduate major, but no later than the quarter prior to the expected completion of the undergraduate degree.

The student may meet the degree requirements in the more advantageous of the following two ways: by first completing the 180 units required for the B.S. degree and then completing the three quarters required for the M.S. or the M.A. degree; or by completing a total of 15 quarters during which the requirements for the two degrees are completed concurrently. In either case, the student has the option of receiving the B.S. degree upon meeting all the B.S. requirements or of receiving both degrees at the end of the coterminal program.

Students earn degrees in the same department or program, in two different departments, or even in different schools; for example, a B.S. in Physics and an M.S. in Geological Sciences. Students are encouraged to discuss the coterminal program with their advisers during their junior year. Additional information is available in the individual department offices.

University requirements for the coterminal master's degree are described in the "Coterminal Master's Program (http://exploredegrees.stanford.edu/cotermdegrees/)" section. University requirements for the master's degree are described in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees/#masterstext)" section of this bulletin.

Graduate Programs in the School of Earth, Energy and Environmental Sciences

Admission to the Graduate Program

A student who wishes to enroll for graduate work in the school must be qualified for graduate standing in the University and also must be accepted by one of the school's four departments or the E-IPER program. Admission to one department of the school does not guarantee admission to other departments.

Faculty Adviser

Upon entering a graduate program, the student should report to the head of the department or program who arranges with a member of the faculty to act as the student's adviser. Alternatively, in several of the departments, advisers are established through student-faculty discussions prior to admission. The student, in consultation with the adviser(s), then arranges a course of study for the first quarter and ultimately develops a complete plan of study for the degree sought.

Financial Aid

Detailed information on scholarships, fellowships, and research grants is available from the school's individual departments and programs.

Dean: Stephan A. Graham

Senior Associate Dean, Strategic Planning and Facilities: Scott Fendorf

Senior Associate Dean, Faculty Affairs: Jonathan Payne

Senior Associate Dean, Educational Affairs: Tiziana Vanorio

Associate Dean, Educational Affairs: Robyn Dunbar

Assistant Dean, Student Services: Alyssa Ferree

Lecturers: Ryan Petterson, Jennifer Saltzman, Audrey Yau

Courses

EARTH 1A. Know Your Planet: Research Frontiers. 1 Unit.
You are interested in the challenges that face our planet, but you are not sure about the career opportunities in the earth, energy, and environmental sciences. The breadth of possibilities will surprise you! In this course, you will meet faculty working on a diverse array of environmental problems, learn about the career paths of working professionals in the earth sciences, and hear from expert panels about post-graduation pathways available to you in the earth, energy, and environmental sciences. Open to all students. May be repeated for credit.

EARTH 1B. Know Your Planet: Big Earth. 1 Unit.
Interested in Big Data and how to apply it to global environmental and sustainability challenges? This course provides an introduction to Big Data and its applications in solving global challenges such as meeting global energy needs, food and water security, climate change, and natural hazards. The first half of the course will focus on foundational concepts of Big Data; the second half of the course will focus on applications of Big Data while introducing students to Stanford Earth alumni who are currently using these concepts in their work. May be repeated for credit.

EARTH 1C. Know Your Planet: Science Outside. 1 Unit.
One of the most important ways to learn about the world is to go out and explore it. Over the course of two day-long field trips during the weekend of May 11 & 12, students will learn and implement hands-on skills for conducting research outdoors in the natural environment. No previous field-work experience necessary. By focusing on the local geology, geomorphology, soils, ecology, and marine biology surrounding the Stanford campus, we will use careful observation, standard methods for data collecting, and analytical tools to answer fundamental questions about earth and ecosystem function. Along the way, we will also practice basic skills, from hiking to critical thinking, essential for conducting science outside of the controlled environment of the lab. This class is all about learning by doing, so be prepared to get your hands dirty and your feet wet while enjoying the sunshine and fresh air. In addition to the field weekend, this class also includes a mandatory pre-trip evening meeting. Enrollment is limited to 20 students; preference given to freshmen and sophomores; interested students must complete this form: https://goo.gl/forms/p3cEpvGJvjI9EaTm2.

EARTH 1D. Know Your Planet: Careers in Earth, Energy, and the Environment. 1 Unit.
Meet working professionals in the earth sciences, network with Stanford Earth alums, and learn from expert panels about a variety of career paths and post-graduation opportunities available to you in the earth, energy, and environmental sciences. Open to all students.

EARTH 2. Climate and Society. 3 Units.
How and why is the climate changing? How might a changing climate affect human society? And what can we do to alter the course of climate change and adapt to any climatic changes that do occur? This course provides an introduction to the natural science and social science of climate change. The focus is on what science tells us about the causes, consequences, and solutions to climate change, as well as on how scientific progress is made on these issues.

EARTH 5. Geokids: Earth Sciences Education. 1 Unit.
Service learning through the Geokids program. Eight weeks of supervised teaching to early elementary students about Earth sciences. Hands-on teaching strategies for science standards-based instruction.

EARTH 10. Design for a Habitable Planet. 1 Unit.
Climate change is happening. As a society, we know we need to accommodate it, design for it, and slow its progress, yet as individuals many of us struggle to take meaningful action. This class will use the iconic landscapes of California as a lens to address this challenge. How will they differ in 2025, 2050, 2100? During the course we will learn about the science of global change and the ways in which California may dramatically differ in the future as a result of changing temperatures and rainfall patterns, rising sea levels, shifts in flora and fauna, and decisions about the built environment and infrastructure. Using methodologies of human-centered design, we will explore how iconic landscapes influence perceptions of global change. We will generate ideas for communicating the impact of projected change and experiment with different ways of creating a sense of urgency. This class is for students interested in the impacts global change and in seeking new and innovative ways to communicate it. The course will be co-taught by faculty from the School of Earth, Energy and Environmental Sciences and the d.school. Apply by September 8. You can read more about the course and apply here: https://dschool.stanford.edu/classes/design-for-a-habitable-planet. Applicants will be selected to ensure a diversity of backgrounds. Course will be limited to 16 participants. Meeting times: Tue: 4:30 to 5:50 beginning 10/24, Saturday 10/28 All day field trip.

EARTH 14. Our National Parks. 2 Units.
Explore the history and natural science of three national parks proximal to Stanford. Under the guidance of instructors, students will work in teams to learn about chosen aspects of these parks, develop dynamic self-guided tours for public consumption, and implement (and publish) these tours using the XibitEd app for iPhones. Students will learn how to present their findings to a general, non-scientific audience, delineate physical locations at which storytelling will take place through the XibitEd system, and create and configure the content for the system. The course will culminate in the publishing of the experiential learning tours, as well as a weekend-long field trip to the Pinnacles National Park.
Same as: EARTH 114A, GEOLSCI 14, GEOLSCI 114A

EARTH 15. Living on the Edge. 1 Unit.
A weekend field trip along the Pacific Coast. Tour local beaches, geology, and landforms with expert guides from the School of Earth, Energy & Environmental Sciences. Enjoy a BBQ dinner and stay overnight in tents along the coast. Get to know faculty and graduate students in Stanford Earth. Transportation, meals, and camping equipment are provided at no cost to student participants. AY2020-21 offering is dependent on the COVID-19 health situation.
Same as: GEOLSCI 5

EARTH 42. Moving and Shaking in the Bay Area. 4 Units.
Active faulting and erosion in the Bay Area, and its effects upon landscapes. Earth science concepts and skills through investigation of the valley, mountain, and coastal areas around Stanford. Faulting associated with the San Andreas Fault, coastal processes along the San Mateo coast, uplift of the mountains by plate tectonic processes, and landsliding in urban and mountainous areas. Field excursions; student projects.
Same as: GEOLSCI 42

EARTH 81. Stanford EARTH Spring Break Field Trip. 2 Units.
(Previously offered as EARTH 191). Spring break field trip to various locations in Eastern California (may include Owens Valley, eastern Sierras, White Mountains, Death Valley). Exact locations will vary by term. Topics may cover natural history, geology, and ecology. Students will learn tools for self-directed learning (including problem solving, critical thinking, observation skills, giving and receiving feedback) and will have the opportunity to practice those skills through a variety of activities including field sketching, team problem solving, reading maps, and navigating in teams. Expect moderately strenuous hiking, living in a communal dorm-style environment, and group chores. Engaged participation expected, no prior knowledge or experience required, open to all majors. No course fee. Food, lodging, and necessary equipment is provided at no cost to student participants. Students interested in participating must complete this web form: https://forms.gle/4xdpuqoJMXVxyCLf9.

EARTH 83. Nature Journaling. 2 Units.
This course will introduce students to the fundamentals of nature journaling. Nature journaling is a practice of observing and recording the natural world, much as one might record their lives in a daily journal. Nature journaling provides a path for sharpening curiosity and attention as it deepens understanding and appreciation of nature. In this class, students will learn the basics of observation, inquiry, and engagement with your surroundings. You will learn basic drawing techniques to help achieve those learning outcomes. Using common resources (pens, pencils, paper) students will record observations, drawings, diagrams, descriptions and maps. This course is designed to be interactive and community based. Students will share photos of their journal pages and will give and receive constructive feedback from both instructors and peers. Content will include botany, wildlife, geology, and astronomy, while still primarily focusing on the process of observing and recording. No prior knowledge or experience is required. Assignments can be done in the wilderness, in your backyard, or even in your house. (Remote delivery in Spring 2020).

EARTH 100. Research Preparation for Undergraduates. 1 Unit.
For undergraduates planning to conduct research during the summer with faculty in the School of Earth, Energy & EnvironmentaL Sciences. Readings, oral presentations, proposal development. May be repeated for credit.

EARTH 114A. Our National Parks. 2 Units.
Explore the history and natural science of three national parks proximal to Stanford. Under the guidance of instructors, students will work in teams to learn about chosen aspects of these parks, develop dynamic self-guided tours for public consumption, and implement (and publish) these tours using the XibitEd app for iPhones. Students will learn how to present their findings to a general, non-scientific audience, delineate physical locations at which storytelling will take place through the XibitEd system, and create and configure the content for the system. The course will culminate in the publishing of the experiential learning tours, as well as a weekend-long field trip to the Pinnacles National Park.
Same as: EARTH 14, GEOLSCI 14, GEOLSCI 114A

EARTH 115. Wrigley Field Program in Hawaii Preparation. 1 Unit.
Preparatory course for the Wrigley Field Program in Hawaii. This course will introduce students to the faculty and topics that will be covered during the fall program. It will also include logistics content, readings, and an introduction to Hawaiian history and culture. Instructor approval required. Open only to students accepted to the 2020 Wrigley program.

EARTH 117. Earth Sciences of the Hawaiian Islands. 4 Units.
Progression from volcanic processes through rock weathering and soil-ecosystem development to landscape evolution. The course starts with an investigation of volcanic processes, including the volcano structure, origin of magmas, physical-chemical factors of eruptions. Factors controlling rock weathering and soil development, including depth and nutrient levels impacting plant ecosystems, are explored next. Geomorphic processes of landscape evolution including erosion rates, tectonic/volcanic activity, and hillslope stability conclude the course. Methods for monitoring and predicting eruptions, defining spatial changes in landform, landform stability, soil production rates, and measuring biogeochemical processes are covered throughout the course. This course is restricted to students accepted into the Earth Systems of Hawaii Program.
Same as: EARTHSYS 117, ESS 117

EARTH 126X. Hard Earth: Environmental Justice. 1 Unit.
Environmental policies often have disparate impacts on marginalized people. The fall 2019 Hard Earth series will feature biweekly talks by Stanford graduate students who are investigating pressing questions at the intersection of environmental justice and health, energy, and climate change. On the alternate weeks, students who have enrolled to take the full Hard Earth series as a one-unit course (CEE 126XYZ | EARTH 126XYZ) meet for a deeper discussion about the prior week¿s presentation. There will be one culminating talk by a non-student sustainability expert. Learn more about Hard Earth here: https://roblesustainability.stanford.edu/initiatives/hard-earth.
Same as: CEE 126X

EARTH 126Y. Hard Earth: Stanford Graduate-Student Talks Exploring Tough Environmental Dilemmas. 1 Unit.
Environmental disasters are striking with alarming frequency. Many, including wildfires and ecosystem collapse, are hitting California. The winter 2019 Hard Earth series will feature biweekly talks by Stanford graduate students whose research probes how people are coping with, adapting to, and changing their lives in the face of environmental catastrophe. Their talks will focus on events close to home in California. Students who choose to enroll in the entire quarterly series as a 1-unit class will, in the weeks between the talks, discuss what¿s happening in California in the context of the rest of the world.
Same as: CEE 126Y

EARTH 126Z. Hard Earth: The Interconnected Impacts of Global Climate Change. 1 Unit.
The COVID crisis makes one thing clear: society is ill-equipped to deal with disasters that do not respect borders and can cripple social and economic systems. Climate change, though radically different from a virus, similarly is a global threat. This class will feature virtual biweekly talks by four graduate students whose research probes a changing climate's already-occurring impacts on livelihoods, jobs, food, and social safety nets around the world. In the weeks in between the talks, we will hold a group discussion to explore how we can, as a global society, re-imagine our response to disaster.
Same as: CEE 126Z

EARTH 131. Pathways in Sustainability Careers. 1 Unit.
Interactive, seminar-style sessions expose students to diverse career pathways in sustainability. Professionals from a variety of careers discuss their work, their career development and decision-points in their career pathways, as well as life style aspects of their choices.
Same as: EARTHSYS 131

EARTH 165H. Big Earth Hackathon Wildland Fire Challenge. 3 Units.
Participate in Stanford's Big Earth Hackathon challenge on wildland fires by finding an innovative solution to wildland fire prediction, prevention, and/or evacuation. Students work in self-organized diverse teams of 2-4 students in weeks 1-8, with a final presentation of the work on Friday May 29. The teams will spend the first few weeks designing their specific team problem/scope/goals under one of three primary areas of focus. Guidance in the design and solution processes will be provided by faculty, industry and/or community leaders. Workshops in data analysis, programming, GIS, and fundamental issues related to wildfires will be provided at the start of the quarter to give students tools and insights to define and tackle problems.
Same as: CEE 165H, CEE 265H, EARTH 265H

EARTH 191. Stanford EARTH Field Courses. 1-2 Unit.
Four- to seven-day field trips to locations of geologic and environmental interest. Includes trips offered during Spring break. May be repeated for credit.
Same as: GEOLSCI 191

EARTH 193. Natural Perspectives: Geology, Environment, and Art. 1 Unit.
Multi-day field trip that combines exploration of regional geology, ecology, and environmental history with guided drawing exercises in the Eastern Sierra Nevada of California. We¿ll visit several sites of geologic and environmental interest, discuss their formation and significance, and use drawing as tool for close observation. Students will gain an understanding of the natural processes shaping California, acquire new skills and techniques for artistic expression, and gain an appreciation for how scientific and aesthetic perspectives complement and enhance one another in the study of nature. No previous scientific or artistic experience is required. Preference for freshmen and sophomores.
If you are interested in signing up for the course, complete this pre-registration form: https://stanforduniversity.qualtrics.com/SE/?SID=SV_9RF2rDopROzwOxf.
Same as: EARTHSYS 193

EARTH 197. Human-Centered Design Methods in Data Science. 1 Unit.
In today's society, the most pressing data science problems we face exist in a complex sociotechnical ecosystem and cannot be solved using the numbers alone. In this five-week short course, students will learn how to apply human-centered design methods to solve data science problems and how to pair traditional data with a diversity of other types of data to redefine problems and gain innovative insight. The course will focus on empathy-based frameworks to analyze data, problem definition and redefinition, and ideation. Additional skills in critique and storytelling will also be covered. Classes will be highly interactive and team-based. This course will offer skills in support of the teams working toward the Big Earth Hackathon Wildland Fire challenge (CEE 265H, EARTH 165H, EARTH 265H).
Same as: CME 197

EARTH 200A. Your Professional Development. 1 Unit.
Navigating the transition from student to professional is a daunting and often times unpredictable journey. This course is designed to help start the process of career planning and development early on. Beginning with navigating career uncertainty, through thoughtful self-assessment, to resume building, the power of negotiation, and managing up - this course builds a solid foundation on which to explore your long-term career goals.

EARTH 200B. Your Personal Development. 1 Unit.
Success in both your professional and personal life requires emotional, financial, and social intelligence. This course is designed to build on those soft skills that will better prepare you to successfully navigate your life. Develop skills in areas ranging from emotional intelligence, decision making courage, living well under pressure, managing procrastination, conflict resolution, relationship building, influencing, ethics & integrity, and financial literacy.

EARTH 200P. Your Professional Development Practicum. 1 Unit.
Developing a strong portfolio of skills and tools takes resources and partners. This practicum enables the freedom to explore and develop a specific component of your professional portfolio with instructor support. You will set a professional development goal at the start of the quarter and then build a self-directed set of experiences that engage on-campus resources, professional society opportunities, and/or external partners to explore and develop new skills. Completion will include reflection on the experience, feedback from peers and mentors, and a concrete product that expands your professional ¿toolkit.¿ This practicum is recommended for latter stage graduate students, or following completion of Earth 200A.

EARTH 202. PhD Students on the PhD. 1 Unit.
This seminar is designed for coterms and upperclassmen who are considering pursuing a PhD in earth science fields but want to know what that path really entails. Consisting of small-group discussions with current PhD students, this course will feature conversations on a range of PhD research topics and will also delve into the substance of the PhD experience itself. We will explore PhD students' programs and career paths: the milestones, processes, and issues that guide their decisions and shape their PhD experiences. Discussion themes will be determined partly in advance and partly based on the interests of participants and could include topics such as choosing a PhD program or research question, interdisciplinarity, community engagement, or work/life balance.

EARTH 203. Diversity and Inclusion in the Geosciences. 1 Unit.
This course will prepare students to address the participation and inclusion challenges uniquely faced in the geosciences. By bringing awareness to specific tools and tactics which improve learning and working environments, we hope to help others develop inclusive environments where diversity is valued and celebrated. Diverse thinking coupled with inclusive practices improves science and team performance. In the past 40 years, the geosciences have had the lowest diversity of all STEM fields within higher education. Using insights from recent literature and perspectives from guest speakers, we will evaluate current practices and identify those that hold promise in improving broader participation and inclusion in the geosciences. Discussions will focus on actions that individuals can take to promote greater inclusion within every level of higher education in the earth sciences.

EARTH 214. Software Design in Modern Fortran for Scientists and Engineers. 3 Units.
This course introduces software design and development in modern Fortran. Course covers the functional, object-oriented-, and parallel programming features introduced in the Fortran 95, 2003, and 2008 standards, respectively, in the context of numerical approximations to ordinary and partial differential equations; introduces object-oriented design and design schematics based on the Unified Modeling Language (UML) structure, behavior, and interaction diagrams; cover the basic use of several open-source tools for software building, testing, documentation generation, and revision control. Recommended: Familiarity with programming in Fortran 90, basic numerical analysis and linear algebra, or instructor approval.
Same as: CME 214

EARTH 218. Communicating Science. 3 Units.
For undergraduates and graduate students interested in teaching science in local schools. Inquiry-based science teaching methods. How to communicate scientific knowledge and improve presentations. Six weeks of supervised teaching in a local school classroom. Prerequisite: course in introductory biology, geology, chemistry, or marine sciences.

EARTH 219. OPINION WRITING IN THE SCIENCES. 1 Unit.
Part exposition, part reflection, part synthesis, research-driven opinion writing can be found everywhere from the op-ed pages of daily newspapers, to the commentary sections of journals such as Nature and Science, to the sort of wide-ranging reviews found in the New York Review of Books. In this course, advanced doctoral students will study the form, and work with the instructors to develop a publication-quality opinion essay on an aspect of their own field. Admission is limited and by application only. Contact thayden@stanford.edu.

EARTH 251. Negotiation. 3 Units.
Students learn to prepare for and conduct negotiations in a variety of arenas including getting a job, managing workplace conflict, negotiating transactions, and managing personal relationships. Interactive class. The internationally travelled instructor who has mediated cases in over 75 countries will require students to negotiate real life case studies and discuss their results in class. Application required before first day of class; students should enroll on Axess and complete the application on Canvas before March 20, 2020. Note: there is a class fee of $130 for access to case files and readings.
Same as: CEE 151, CEE 251, PUBLPOL 152

EARTH 265H. Big Earth Hackathon Wildland Fire Challenge. 3 Units.
Participate in Stanford's Big Earth Hackathon challenge on wildland fires by finding an innovative solution to wildland fire prediction, prevention, and/or evacuation. Students work in self-organized diverse teams of 2-4 students in weeks 1-8, with a final presentation of the work on Friday May 29. The teams will spend the first few weeks designing their specific team problem/scope/goals under one of three primary areas of focus. Guidance in the design and solution processes will be provided by faculty, industry and/or community leaders. Workshops in data analysis, programming, GIS, and fundamental issues related to wildfires will be provided at the start of the quarter to give students tools and insights to define and tackle problems.
Same as: CEE 165H, CEE 265H, EARTH 165H

EARTH 305A. Teaching in the field: Basic skills for working with students in the field. 1-2 Unit.
This workshop series introduces the basics of teaching, working, and living in the field with students, from first aid to university policies to pedagogy. We will discuss skills and techniques necessary to keep students safe, to maximize their learning outcomes, and to promote best practices for field teaching, particularly within the natural sciences. Open to all graduate students.

EARTH 305B. Teaching in the Field: Field Practical. 1-2 Unit.
Participate in the logistics and academic content of EARTH 191 field trip and serve as primary trip leaders. Discussions prior to, and during, the field trip that cover pedagogic, safety, risk management, and social issues that pertain to teaching field trips. Specific topics will be chosen based on the interest and abilities of enrolled students.

EARTH 310. Computational Geosciences Seminar. 1 Unit.
Weekly lectures focusing on high-performance computing in geoscientific research by experts from academia, national laboratories, industry, and doctoral students. May be repeated for credit.

EARTH 400. Directed Research. 3 Units.
Independent research for graduate student projects.

EARTH 401. Curricular Practical Training. 1 Unit.
Curricular Practical Training.