

EARTH SCIENCES (EAR)

EAR 500 Selected Topics (1-6 Credits)

Arts & Sciences

Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester. Repeatable

EAR 507 Experimental Skills (0 Credits)

Arts & Sciences

EAR 510 Paleolimnology (3 Credits)

Arts & Sciences

The records of environmental change contained within lake sediments. Basic background in limnology followed by field/laboratory research projects and presentations. Upper division undergraduate science majors.

EAR 544 Quaternary Environmental and Climate Change (3 Credits)

Arts & Sciences

Proxy records from marine, lacustrine, glacial, and terrestrial environments for climate and environmental change during the Quaternary. Comparison with numerical models of atmosphere and oceans. Discussion of current literature and the potential for future global change.

EAR 590 Independent Study (1-3 Credits)

Arts & Sciences

Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department. Repeatable

EAR 600 Selected Topics (1-6 Credits)

Arts & Sciences

Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester. Repeatable

EAR 601 Hydrogeology (3 Credits)

Arts & Sciences

Double-numbered with EAR 401

Fundamentals of groundwater hydraulics. Aquifer flow systems analysis and evaluation. Groundwater-surfacewater relationships. Groundwater chemistry. Additional work required of graduate students. Shared Competencies: Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 602 Numerical Methods in Geosciences (3 Credits)

Arts & Sciences

Double-numbered with EAR 402

Numerical methods and data analysis in geosciences using MATLAB. Topics will include basic statistics for univariate and bivariate datasets including linear regression and interpolation, time-series analysis, the discrete Fourier transform, numerical integration and finite differences. Additional work required of graduate students. Shared Competencies: Information Literacy and Technological Agility (<https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/>); Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 603 Geomorphology (3 Credits)

Arts & Sciences

Double-numbered with EAR 403

Landscape formation and evolution as a function of hydrogeologic, glacial, eolian, and tectonic processes acting on Earth materials. Lecture, labs, and field trips, including some weekends. Additional work required of graduate students.

Shared Competencies: Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 604 Advanced Structural Geology (3 Credits)

Arts & Sciences

Double-numbered with EAR 404

Selected topics in structural geology and tectonics focusing on the mechanics and kinematics of lithospheric deformation. Fundamentals of stress, strain, brittle and ductile deformation, microstructures and rheology. Additional work required of graduate students. Advisory recommendation Prereq: EAR 314 and EAR 333

EAR 605 Global Change:Geologic Record (3 Credits)

Arts & Sciences

Double-numbered with EAR 405

The geologic record provides perspective for evaluating future global change. This course will focus on the evolution of climate through Earth's 4.6 billion years and how this record is preserved in ancient rocks and sediments.

Shared Competencies: Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 606 Reflection Seismology: Theory and Practice (3 Credits)

Arts & Sciences

Double-numbered with EAR 406

Students will develop a working understanding of the strengths and pitfalls of the method through classroom lectures, exercises, and hands-on data processing using PROMAX seismic processing software. Prerequisites: coursework/experience in geophysics/permission of instructor. Additional work required of graduate students.

EAR 607 Climate Change and Human Origins (3 Credits)

Arts & Sciences

Cross-listed with ANT 639

Double-numbered with EAR 407, ANT 439

This course considers the influence of long term climate changes on hominid evolution and human adaptation, as well as how abrupt climate events and transitions may have impacted the distribution of human populations, the development of agriculture, human conflict and societal change. Additional work required of graduate students. Shared Competencies: Critical and Creative Thinking (<https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/>)

EAR 608 Sedimentary Basin Analysis (3 Credits)

Arts & Sciences

Double-numbered with EAR 408

Analysis of sedimentary basins in various tectonic settings, including the study of crustal and surficial processes. Uses techniques of subsurface analysis including the interpretation of seismic reflection data sets. Additional work required of graduate students. Advisory recommendation Prereq: EAR 517.

EAR 609 Environmental Data Science (3 Credits)*Arts & Sciences*

Cross-listed with CEE 609

Introduction to data science methods for environmental analysis in the R and Python programming languages. Reproducible scientific computing; open geospatial data sources; common structures of environmental data; space/time applications of supervised machine learning; and high throughput computing.

EAR 610 Applications of GIS in the Earth Sciences (3 Credits)*Arts & Sciences*

Double-numbered with EAR 410

Introduction to some of the many uses of image and topographic data within a geographic information system (GIS) to extract information relevant to the study of the Earth. Additional work required of graduate students.

EAR 611 Environmental Geophysics (3 Credits)*Arts & Sciences*

An introduction to the study of the Earth's near surface using geophysical methods and quantitative data analysis, specifically: seismic reflection and refraction, gravity, magnetic, electrical and electromagnetic methods. Participation in geophysical field survey is required.

EAR 612 HydroReads (1 Credit)*Arts & Sciences*

A forum for learning about and discussing research in water science.

Participants review and discuss papers or their own current work.

Occasionally participants host external lecturers.

Repeatable 3 times for 3 credits maximum

EAR 613 Physical Hydrology (3 Credits)*Arts & Sciences*

Cross-listed with CEE 613

Double-numbered with CEE 413, EAR 413

Fundamentals of watershed hydrology presented from a physical hydrology perspective; course topics include: the water cycle, hydrologic processes, streamflow generation, groundwater-surface water interactions, and introduction to hydrologic modeling concepts. Additional work required of graduate students.

Shared Competencies: Information Literacy and Technological Agility (<https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/>); Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 614 The Holocene: Climate and Environmental Change (3 Credits)*Arts & Sciences*

Double-numbered with EAR 414

This course introduces students of all disciplines to the science behind our understanding of Earth's climate and environmental changes during the past 12,000 years. Lectures and discussions focus on interactions between climate, landscapes, and humans. Additional work required for graduate students.

Shared Competencies: Critical and Creative Thinking (<https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/>); Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 615 Introduction to Climate Dynamics (3 Credits)*Arts & Sciences*

Double-numbered with EAR 415

The course introduces the physical principles underlying the climate system. Topics include Earth's energy balance; circulation; climate variability; climate feedbacks and climate change, observational evidence of climate change. Additional work required for graduate students.

Shared Competencies: Information Literacy and Technological Agility (<https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/>); Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 616 Practicum in Earth and Environmental Scientific Communication (2 Credits)*Arts & Sciences*

Double-numbered with EAR 416

Being able to effectively communicate is an essential part of being a successful scientist. In this practicum you will learn techniques to refine your scientific communication skills (oral, written, and graphical). Additional work is required for graduate students.

Shared Competencies: Communication Skills (<https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/>)

EAR 617 Geochemistry (3 Credits)*Arts & Sciences*

Double-numbered with EAR 417

Chemistry of Earth processes, including basic thermodynamics, solution chemistry, isotopic chemistry, and kinetics; magmatic crystallization, isotope fractionation, formation of carbonate and evaporitic sediment, ion exchange in clays, and Cosmochemistry.

Advisory recommendation Prereq: EAR 314 and CHE 107 and 117

Shared Competencies: Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 618 Petrology (4 Credits)*Arts & Sciences*

Double-numbered with EAR 418

Introduction to the origin of igneous, metamorphic, and sedimentary rocks. Classifications, compositions, tectonic setting, and processes governing the distribution of rocks within the Earth. Lecture, laboratory, and fieldtrips. Additional work required of graduate students.

EAR 619 Environmental Aqueous Geochemistry (3 Credits)*Arts & Sciences*

Double-numbered with EAR 419

Fundamentals of aqueous geochemistry in ground water and surface water in the context of carbonate and silicate dissolution, reactions governing metal oxidation and reduction, mixing of waters and isotopic characterization. One year of college chemistry required. Additional work required of graduate students.

Shared Competencies: Communication Skills (<https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/>); Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 620 Contaminant Hydrogeology (3 Credits)*Arts & Sciences*

Double-numbered with EAR 420

Fundamentals of solute transport, major classes of groundwater contamination, remediation strategies, natural attenuation characterization, fingerprinting of contaminant types. Additional work required of graduate students.

Advisory recommendation Prereq: EAR 401

EAR 622 Applications of Electron Probe Microanalysis (3 Credits)*Arts & Sciences*

Double-numbered with EAR 422

Learn practical aspects of sample preparation, perform electron probe microanalysis for research projects, develop theoretical background of electron specimen interactions for imaging and X-ray spectroscopy, and interpret results. Additional work for graduate students.

EAR 623 Stable Isotope Geochemistry (3 Credits)*Arts & Sciences*

Double-numbered with EAR 423

A survey of the chemical, physical and biological factors controlling stable isotope distributions with applications to the Earth and environmental sciences. Additional work for graduate students.

EAR 624 Paleoeology (3 Credits)*Arts & Sciences*

Principles and applications of paleoeology, using examples from both marine and terrestrial ecosystems. Analysis of fossil communities. Ecology of mass extinctions. Functional morphology. Predator-prey relationships. Effects of climate/environmental change on ecosystems and species. Discussion oriented combination of lecture, lab, and field trips.

Advisory recommendation Prereq: EAR 325

EAR 625 Statistics in Earth and Environmental Sciences (3 Credits)*Arts & Sciences*

Double-numbered with EAR 425

This course introduces students to the art and science of statistics in the Earth and environmental sciences. Students will explore and analyzing data using a variety of statistical methods with data and practical examples from the earth and environmental sciences. The course introduces statistical computing in the R language. Additional work required of graduate students.

EAR 627 Modern Sediments (3 Credits)*Arts & Sciences***EAR 628 PaleoX Research Seminar (1 Credit)***Arts & Sciences*

Seminar discussion focusing on current literature and ongoing research related to ancient climates, depositional environments, ecosystems, and biogeochemical cycles. Emphasis is placed on critical thinking, hypothesis testing, and data analysis.

Repeatable 3 times for 3 credits maximum

EAR 629 Topics in Paleobiology (3 Credits)*Arts & Sciences*

Double-numbered with EAR 429

Current research in paleobiology with a topical focus. Subjects might include macroevolution, evolutionary paleoeology, extinctions and radiations, stratigraphic paleontology, etc. Additional work required of graduate students.

Repeatable 3 times for 9 credits maximum

Advisory recommendation Prereq: EAR 325

EAR 630 Topics in Thermochronology & Tectonics (2 Credits)*Arts & Sciences*

Double-numbered with EAR 430

Seminar will focus on research topics in thermochronology and tectonics from current literature. Additional work required of graduate students. Repeatable 4 times for 8 credits maximum

EAR 631 Plate Tectonics (3 Credits)*Arts & Sciences*

Double-numbered with EAR 431

Tectonic development of the Earth; definition of plates, their boundaries, motions, and driving forces. Analysis and modeling of plate motions. Additional work required of graduate students.

Advisory recommendation Prereq: EAR 333 and PHY 212 and MAT 296

Shared Competencies: Scientific Inquiry and Research Skills (<https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/>)

EAR 632 Seafloor Spreading and Oceanic Lithosphere (3 Credits)*Arts & Sciences*

Double-numbered with EAR 432

An investigation of the products and processes of seafloor spreading from the perspective of geological and geophysical studies of mid-ocean ridge spreading centers, oceanic lithosphere and ophiolite complexes. Additional work required of graduate students.

Advisory recommendation Prereq: EAR 333

EAR 633 Topics in Active Tectonics (2 Credits)*Arts & Sciences*

Double-numbered with EAR 433

The use of modern methods to study tectonic processes along active plate margins, focusing on the evolution of topography expressed in orogen and basin development, including the style and accommodation of crustal and mantle deformation. Additional work required of graduate students

Repeatable 3 times for 6 credits maximum

Advisory recommendation Prereq: EAR 333 or EAR 431.

EAR 634 Professional Development (1 Credit)*Arts & Sciences*

This seminar provides students the skills needed to develop research skills and explore career pathways within the Earth and environmental sciences. The seminar will consist of lectures by the instructors and outside speakers along with in-class exercises related to the development of soft skills and promoting your work to diverse audiences.

EAR 635 Geophysics (3 Credits)*Arts & Sciences*

Double-numbered with EAR 435

Fundamental geophysical parameters; seismology and Earth structure; gravity and magnetic fields with application of potential theory; terrestrial rotation and shape; heat flow, thermal state, and evolution of the Earth. Additional work required of graduate students.

Advisory recommendation Prereq: EAR 333 and MAT 296

EAR 636 Foundations of Geosciences (1 Credit)*Arts & Sciences*

This seminar course for first-year graduate students explores earth science topics including the solid earth, paleontology, Earth's climate (past and present), and hydrology. Participants review, present, and discuss papers.

EAR 643 Advanced Topics in Geomorphology (3 Credits)*Arts & Sciences*

Double-numbered with EAR 443

This course presents selected papers from the literature that contribute to current thought in geomorphology and later focus on a topic that can vary from year to year. Additional work required of graduate students.

Repeatable 2 times for 6 credits maximum

Advisory recommendation Prereq: EAR 603

EAR 644 Thermochronology (3 Credits)*Arts & Sciences*

Double-numbered with EAR 444

Methods used in Earth Sciences to determine temperature-time histories of crustal terranes including $^{40}\text{Ar}/^{39}\text{Ar}$, fission track, and U-Th/He techniques. Diffusion theory and applications of thermochronology to tectonics and landscape evolution, P-T-t paths of crustal terranes.

Additional work required of graduate students.

Advisory recommendation Prereq: EAR 418

EAR 655 Geochemical Patterns in the History of Earth and Life (3 Credits)*Arts & Sciences*

Double-numbered with EAR 455

Insights gained from the geochemistry of fossils and sedimentary sequences into the history of the Earth's surface. Emphasis on relationships between the biological world and the physical environment as revealed through stable and radiogenic isotopes and elemental chemistry. Additional work required of graduate students.

Advisory recommendation Prereq: EAR 617

EAR 659 Isotope Geochemistry (3 Credits)*Arts & Sciences***EAR 660 Advanced Hydrologic Field Methods (3 Credits)***Arts & Sciences*

Hands-on experience using current instrumentation and measurement techniques in hydrology. Emphasizing fundamental theory governing application, demonstrations of application from the literature and field experiments.

EAR 665 Groundwater Modeling (3 Credits)*Arts & Sciences*

Fundamentals of groundwater and solute movement in the subsurface and how these processes are simulated by numerical finite-difference models. Topics include conceptual model development, boundary conditions, calibration and sensitivity analysis.

Advisory recommendation Prereq: EAR 401

EAR 666 The SESSion - Solid Earth Seminar Series (1 Credit)*Arts & Sciences*

A theme-based solid Earth seminar that explores selected papers to gain a holistic view of the Solid Earth sciences. Discussion will include observational and experimental/numerical constraints from geophysics, geodesy, geochemistry, and petrology/mineralogy.

Repeatable 3 times for 3 credits maximum

EAR 670 Experience Credit (1-6 Credits)*Arts & Sciences*

Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing. Prereq: permission, in advance, of assigned instructor, department chair, or dean.

Repeatable

EAR 678 Isotope Geology (3 Credits)*Arts & Sciences*

Double-numbered with EAR 478

Isotope geochemistry is used in all branches of Earth Sciences. This course covers the following topics: Radioactive decay, Rb-Sr, Sm-Nd, and Lu-Hf isotope geochemistry; U-Pb geochronology, ^{14}C dating; O, H, and C isotope geochemistry. Additional work required of graduate students.

Advisory recommendation Prereq: EAR 417 or 617

EAR 679 Introduction to Unmanned Aerial Vehicles: Research & Applications (3 Credits)*Arts & Sciences*

Cross-listed with GEO 679

Double-numbered with EAR 479, GEO 479

Introduction to UAV operations, including FAA airspace, platforms and sensors; flight planning, data collection, image processing, and data analysis for geospatial mapping. Applications and societal impacts, including legal, safety, privacy, ethical issues. Additional work required of graduate students.

EAR 683 Departmental Colloquium (1 Credit)*Arts & Sciences*

Double-numbered with EAR 483

Students attend the Department of Earth Sciences colloquium lectures and write up summaries of a subset of talks. Provides exposure to current research in a wide array of Earth Science disciplines. Additional work required of graduate students.

Repeatable 3 times for 3 credits maximum

EAR 685 Stratigraphic Analysis (3 Credits)*Arts & Sciences***EAR 687 Chemical Sedimentology (3 Credits)***Arts & Sciences***EAR 690 Independent Study (1-6 Credits)***Arts & Sciences*

Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.

Repeatable

EAR 860 Advanced Seminars in Geology (1-3 Credits)*Arts & Sciences*

Current literature and problems in specialized fields of geology.

Repeatable

EAR 990 Independent Study (1-6 Credits)*Arts & Sciences*

Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.

Repeatable

EAR 997 Masters Thesis (0-9 Credits)*Arts & Sciences*

Repeatable

EAR 999 Dissertation (1-15 Credits)*Arts & Sciences*

Repeatable