

ERTH - Earth Systems

ERTH 101IN Earth System Sciences: 4 Credits (3 Lec, 1 Lab)

(F, Sp) Examination of basic geologic processes, Earth and planets through geologic time, internal geosystems, and surficial geosystems.

ERTH 201IN Honors Earth System Science: 4 Credits (3 Lec, 1 Lab)

PREREQUISITE: Enrollment in the MSU Honors Program. () Offered on demand. This Honors course explores the complex interactions occurring at all scales between the Earth's geosphere, biosphere, hydrosphere, atmosphere, and anthroposphere. The goal of the course is to understand the Earth as a "system" of interconnected sources of energy through deep geologic time and space

ERTH 212RN Yellowstone: Scientific Lab: 4 Credits (3 Lec, 1 Other)

() Offered Fall, odd years. The Yellowstone region is an unparalleled laboratory for earth scientists. The volcanic, glacial, climatic, and ecological processes that shaped the region will be introduced through lecture, discussions, and projects. Recitation sections and field trips provide additional hands-on experiences. -.

ERTH 303 Weather and Climate: 3 Credits (3 Lec)

PREREQUISITE: EARTH 101IN or EARTH 201IN. (F) The climates of the continents, and their classification, characteristics and interrelationships with other factors of the physical and human environment

ERTH 307 Principles of Geomorphology: 4 Credits (3 Lec, 1 Lab)

PREREQUISITE: EARTH 101IN or EARTH 201IN and GPHY 284. (F) Framework, process, system, and time as factors which control the generation of land forms. Laboratories involve field trips and map interpretation, and computer modeling

ERTH 432R Surface Water Resources: 3 Credits (2 Lec, 2 Lab)

PREREQUISITE: Junior Standing, EARTH 101IN and STAT 216Q or STAT 332 and PHSX 205 or PHSX 220. () Offered on demand. Physical analysis of the surface portion of the hydrologic cycle: climate, evapotranspiration, precipitation, runoff, flooding, stream channels, sediment production, sediment transport and drainage basins. The surface-water resource in terms of regional supply and human use and intervention. Laboratory fee required

ERTH 450R Snow Dynamics and Accumulation: 4 Credits (1 Lec, 3 Lab)

PREREQUISITE: EARTH 101IN or EARTH 201IN, STAT 332, PHSX 205 or PHSX 220, and ACT 160. (Sp) Senior capstone for the Snow Science Option. The accumulation, redistribution, and metamorphism of snow as related to humans. Avalanche, recreation, agriculture, silviculture, runoff, and the alpine environment. Field studies are conducted on a regular basis under rigorous field conditions

ERTH 462 Advanced Geomorphology: 3 Credits (3 Lec)

PREREQUISITE: EARTH 307
COREQUISITE: M 172Q. This course will provide students an advanced view into active, ongoing research in geomorphology. The course is designed for advanced undergraduate students and graduate students who have taken a previous course in geomorphology. Emphasis will be placed on the tools available to analyze and interpret geomorphic processes, active research in the field, and the interactions of geomorphic processes with other fields of geology, geology, hydrology, chemistry, etc

ERTH 484 Climates of the Past, Present and Future: 3 Credits (3 Lec)

PREREQUISITE: EARTH 101IN and Junior standing. (Sp) This course is an opportunity to learn about the history of the western US over the last 2 million years through a critical analysis of current and historic literature. It will provide an overview of the tools and approaches used to study past environmental change, significant events in the climate history of region, the geologic record of ice-age environments, including glaciation, pluvial lakes, and vegetation, the evolution of the postglacial landscape, and important biotic and human events during the Holocene. Co-convened with EARTH 584

ERTH 490R Undergraduate Research: 1-6 Credits (1 Other)

PREREQUISITE: Consent of instructor. (F, Sp, Su) Directed undergraduate research which may culminate in a research paper, journal article, or undergraduate thesis Course will address responsible conduct of research. May be repeated
Repeatable up to 12 credits.

ERTH 491 Special Topics: 1-4 Credits (1-4 Lec, 1-4 Lab)

Offered on demand.
Repeatable up to 4 credits.

ERTH 492 Independent Study: 1-3 Credits (1-3 Other)

(F, Sp, Su) Directed research and study on an individual basis.

ERTH 494 Seminar: 1 Credits (1 Other)

PREREQUISITE: Junior standing and as determined for each offering. (F, Sp) Topics at the upper division level not covered in regular courses. Students participate in preparing and presenting discussion material. Co-convened with EARTH 594
Repeatable up to 4 credits.

ERTH 498 Internship: 2-12 Credits (2-12 Other)

PREREQUISITE: Junior standing, consent of instructor, and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field
Repeatable up to 12 credits.

ERTH 499 Senior Thesis/Capstone: 3 Credits (3 Other)

PREREQUISITE: Senior standing; minimum 3.0 cum gpa; faculty recommendation. (F, Sp, Su) Senior thesis provides an opportunity to conduct research under the supervision of a faculty member leading to the production of a research paper ("mini-thesis") and an oral presentation to the department or at a professional meeting. Excellent preparation for graduate school and professional work

ERTH 505 Geomicrobiology: 3 Credits (3 Other)

(Sp) Offered Spring of even years. The course examines geochemical and microbial interactions that control earth surface processes and ultimately major biogeochemical cycles. The course focuses on how integrated approaches using geochemistry, stable isotope geochemistry and microbial techniques are applied to research problems.

ERTH 512 Mtn & Plns Riparian Proc: 2 Credits (2 Lec, 2 Other)

PREREQUISITE: EARTH 101IN, secondary teaching certification plus two years teaching experience; recommended EARTH 516 and access to the world wide web. Riparian hydrologic and geomorphic processes with examples drawn from the mountains and plains. Ground-water recharge and discharge; Horton overland flow; partial variable runoff areas; riparian best management practices; sapping, types of springs; sediment from slopes. K-12 riparian science education

ERTH 516 North Rocky Mtn Geology: 2 Credits (1 Lab, 1 Other)

(Su) Geologic history of Northern Rocky Mountains, and landscapes from Archean to present. Structural, tectonic, and surficial elements. Field examination of geologic evidence for history of the Gallatin Range, Bridger Range, and Yellowstone National Park. Exploration and development of teaching methods and resources for the K-12 classroom. Offered Summer.

ERTH 519 Watershed Hydrology for Teachers: 3 Credits (1 Lec, 1 Lab, 1 Other)

(Sp) Offered Spring of odd years. Watershed hydrology for teachers explores the relationship of water quality and water quantity. Students in the course will learn about relationships among watershed hydrology, including water quality, water quantity, water inputs and outputs, effects of modification of watersheds and more. Offered Spring.

ERTH 520 Fundamentals of Oceanography for Teachers: 3 Credits (3 Lec)

(Every summer, Spring of even years) This course will provide students with an introduction to the chemical, physical, biological and geological properties of the ocean. Students will learn the complexities of these interrelationships, their influence on terrestrial ecosystems and the impacts of humans on these processes.

ERTH 521 Geology of the Moon for Teachers: 3 Credits (3 Lec)

(Sp) Offered Spring of even years. Geology of the Moon is an on-line course designed for educators interested in learning about the Moon and its history and relationship to Earth. We will explore theories for its formation and the geologic processes that have helped it to evolve including, differentiation, volcanism, impact cratering, space weathering and former, current and upcoming missions to the Moon. Students will review presentations and assigned readings and interactively participate through a combination of on-line discussions, classroom exercises and dynamic activities. Students will keep a course journal that will help them develop future moon-related curricula for their future use. Offered even Springs.

ERTH 522 Teaching Middle School Earth System Science: 3 Credits (3 Lec)

This course for middle school teachers uses Problem Based Learning (PBL) to explore the processes and interactions between the geosphere, hydrosphere, atmosphere, and biosphere. Teachers will examine processes within and among the four major Earth systems and increase pedagogical skills through modeling PBL, teacher networking, and sharing of ideas and resources. Offered even Springs.

ERTH 523 Weather for Elementary and Middle School Teachers: 3 Credits (2 Lec, 1 Lab)

() Offering to be determined. The course is designed to increase content knowledge and understanding of weather processes. It exposes teachers at the elementary and middle school level to using kit-based, hands-on instruction to facilitate the teaching and learning of weather concepts (meteorology). Weekly discussions encourage reflection on learning and teaching and help solidify weather concepts. will also maintain a weather observations journal in which they will apply their skills and knowledge. Assignments and quizzes are included to help with knowledge acquisition. Offered in the Spring (odd years).

ERTH 524 K-14 Earth System Science: 3 Credits (3 Lec)

(F) Participants will learn to find the Internet's abundant digital Earth Systems Science (ESS) resources and use these resources to create Earth Science lessons that integrate the use of Earth Science specific skills, math, and content. Participants will learn to adapt online resources to their own instructional environments at the K-14 levels. Offered Fall.

ERTH 525 Landforms for Elementary Teachers: 1 Credits (1 Lec)

(Su) Do you take scenic drives, walks, or bike rides and wonder how the landscapes around you were formed? Have you taken trips to national parks or through other scenic areas and wondered how America's landscapes can be so different from coast to coast? In this online course we will investigate our landforms and the processes that shaped some of the most prominent and spectacular landmarks and features across the country. To do this, we will look at a variety of landscapes and investigate how they came to look like they do. Through hands-on labs, we will model landforms and encourage sharing and discussions of additional teaching ideas in this course. The principles you learn will increase your confidence in teaching science in general, specifically the science of scenery! Offered Summer.

ERTH 527 Weather & Climate for Teachers: 3 Credits (3 Lec)

(Sp) This graduate course uses weekly readings, discussions, and hands on activities to build a physical understanding of weather and climate, and to equip our teachers and educators with the tools to better prepare and motivate the next generation of Earth scientists. Offered Spring.

ERTH 528 Climate Change for Teachers: 3 Credits (3 Lec)

PREREQUISITE: EARTH 527 or equivalent. (Su) This graduate course uses weekly readings, discussions, and hands on activities to build a physical understanding of weather and climate, and to equip our teachers and educators with the tools to better prepare and motivate the next generation of Earth scientists

ERTH 551 Snow Science Seminar: 3 Credits (2 Lec, 1 Lab)

PREREQUISITE: Graduate Standing; PHYS 211, STAT 332 or STAT 500. (F) Offered Fall of even years. A mixed lecture and laboratory style course providing an in-depth examination of recent developments in snow science based upon current literature, newly published or about to be published literature, field methods and modeling regarding snow science. Topics will depend partially upon the interests of the instructor and student in the course

ERTH 562 Advanced Geomorphology: 3 Credits (3 Lec)

PREREQUISITE: EARTH 307

COREQUISITE: M 172Q or equivalent. () Offered Spring, odd years. This course will provide students an advanced view into active, ongoing research in geomorphology. The course is designed for advanced undergraduate students and graduate students who have taken a previous course in geomorphology. Emphasis will be placed on the tools available to analyze and interpret geomorphic processes, active research in the field, and the interactions of geomorphic processes with other fields of geology, geology, hydrology, chemistry, etc

Repeatable up to 6 credits.

ERTH 583 Topics in Paleoecology: 3 Credits (3 Other)

PREREQUISITE: Graduate Standing or Consent of Instructor. Course examines important themes in paleoecology. Topics change on a yearly basis addressing needs and interests of current students. It is intended for students with an interest in ecology, paleontology and environmental history

ERTH 584 Climates of the Past, Present and Future: 3 Credits (3 Lec, 3 Other)

PREREQUISITE: EARTH 101IN or BIOB 170IN or equivalent. (Sp) This graduate course examines current research and recent developments in Quaternary paleoclimatology in the western U.S. The seminar will be centered around weekly discussions of the primary literature, hands-on experience with international data bases, and class paper and presentation. Co-convened with EARTH 484

ERTH 585 Advances in Geobiology: 1 Credits (1 Other)

Discussion of recent developments in paleontology, paleoecology, biogeochemistry, and biogeography based on current literature and presentation of faculty and student works in progress. Repeatable up to 3 credits.

ERTH 586 Geology of Earthquakes: 1 Credits (1 Lab)

(Su) Course prerequisites as determined for each offering. Topics offered at the graduate level which are not covered in regular courses. Students participate in preparing and presenting discussion material.

ERTH 587 Invertebrate Paleontology for Teachers: 3 Credits (3 Lec)

(Spring (odd years)) This course will focus on the evolution of invertebrate life throughout Earth's history. As a result of this course, students will demonstrate an understanding of evolutionary processes. Through class discussions and assignments, students will identify the vast diversity of both extinct and extant invertebrates, and their interrelationships with one another. At the end of the course, students will be able to: • Describe the evolution and processes involving in organismal change through time • Identify the diversity within invertebrate clades • Describe phylogenetics and the interrelationships of invertebrates • Create a unit of study specific to their teaching situation that incorporates major course content specific to the evolution of vertebrate life.

ERTH 588 Professional Development: 1-3 Credits (1-3 Lec)

PREREQUISITE: Graduate standing, teaching experience and/or current employment in a school organization, consent of instructor and Dean of Graduate Studies. Courses offered on a one-time basis to fulfill professional development needs of in service educators. A specific focus is given to each course which is appropriately subtitled. May be repeated Repeatable up to 3 credits.

ERTH 589 Graduate Consultation: 3 Credits (3 Other)

PREREQUISITE: Master's standing and approval of the Dean of Graduate Studies. This course may be used only by students who have completed all of their course work (and thesis if on a thesis plan) but who need additional faculty or staff time or help

ERTH 590 Master's Thesis: 1-10 Credits (1 Other)

PREREQUISITE: Master's standing. (F, Sp, Su)
Repeatable up to 99 credits.

ERTH 591 Special Topics: 1-4 Credits (1-4 Other)

PREREQUISITE: Upper division courses and others as determined for each offering. Offered on demand. Courses not required in any curriculum for which there is a particular one time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number
Repeatable up to 12 credits.

ERTH 592 Independent Study: 1-4 Credits (1-4 Other)

PREREQUISITE: Graduate standing, consent of instructor, approval of Department Head and Dean of Graduate Studies. (F, Sp) Directed research and study on an individual basis
Repeatable up to 6 credits.

ERTH 594 Seminar: 1-4 Credits (1-4 Other)

(Su) Course prerequisites as determined for each offering. Topics offered at the graduate level which are not covered in regular courses. Students participate in preparing and presenting discussion material.
Repeatable up to 4 credits.

ERTH 595 Historical Geology for Teachers: 3 Credits (1 Lec, 1 Lab, 1 Other)

(F) The course will provide a rigorous overview of the evolution of Earth and its life forms with a focus on the major trends and interactions between geology and life. Additionally, the course will address the primary methods that geologists use to investigate the history of our planet. Throughout the semester students will be required to participating in online class discussions (via Zoom) and complete a class project. The class project will require students to create lesson plans designed to adapt content from the course to their own classrooms.

ERTH 596 Geology of Glacier National Park for Teachers: 2 Credits (1 Lec, 1 Lab)

(Su) A field course for teachers of science examining geologic evidence for the evolution of the rocks and landscape of Glacier National Park and surrounding areas over geologic time. Offered summer.

ERTH 597 Vertebrate Paleontology for Teachers: 3 Credits (2 Lec, 1 Lab)

(Spring (even years)) This course will focus on the evolution of vertebrate life throughout Earth's history. As a result of this course, students will demonstrate an understanding of evolutionary processes. Through class discussions and assignments, students will identify the vast diversity of both extinct and extant vertebrates, and their interrelationships with one another. At the end of the course, students will be able to: • Describe the evolution and processes involving in organismal change through time • Identify the diversity within vertebrate clades • Describe phylogenetics and the interrelationships of vertebrates • Create a unit of study specific to their teaching situation that incorporates major course content specific to the evolution of vertebrate life.

ERTH 598 Internship: 2-12 Credits (2 Other)

PREREQUISITE: Graduate standing, consent of instructor and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field
Repeatable up to 12 credits.

ERTH 690 Dissertation Research: 1-10 Credits (1-10 Other)

PREREQUISITE: Doctoral candidate standing
Repeatable up to 99 credits.

ERTH 694 Doctoral Seminar: 1-3 Credits (1-3 Other)

PREREQUISITE: Doctoral candidate standing
Repeatable up to 6 credits.