**ERTH - Earth Systems**

**ERTH 101N Earth System Sciences: 4 Credits (3 Lec, 1 Lab)**
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. 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)**
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: ERTH 101IN or ERTH 201IN. 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: ERTH 101IN or ERTH 201IN and GPHY 284. 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, ERTH 101IN and STAT 216Q or STAT 332 and PHSX 205 or PHSX 220. 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: ERTH 101IN or ERTH 201IN, STAT 216Q or STAT 332, PHSX 205 or PHSX 220, ACT 160 (or equivalent). Ability to Ski/Board at intermediate level in back country alpine terrain. Junior or Senior standing: STAT 216Q, PHSX 205 or PHSX 220, ERTH 101IN, ACT 160 (or equivalent), or consent of instructor. 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 484 Climates of the Past, Present and Future: 3 Credits (3 Lec)**
PREREQUISITE: ERTH 101IN and Junior standing. 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 ERTH 584

**ERTH 490R Undergraduate Research: 1-6 Credits (1 Other)**
PREREQUISITE: Consent of instructor. 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 (2-4 Lec, 4-8 Lab)**
Repeatable up to 4 credits.

**ERTH 494 Seminar: 1 Credits (1 Other)**
PREREQUISITE: Junior standing and as determined for each offering. Topics at the upper division level not covered in regular courses. Students participate in preparing and presenting discussion material. Co-convened with ERTH 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. 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. 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)**
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: ERTH 101IN, secondary teaching certification plus two years teaching experience; recommended ERTH 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)**
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)**
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)**
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. Offered Spring.
ERTH 521 Geology of the Moon for Teachers: 3 Credits (3 Lec)
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)
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. It 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: 2 Credits (2 Lec)
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)
In this 8 week online course we will investigate landform science. We will look at a variety of landscapes and how they came to look like they do. We will model landforms and encourage sharing and discussions of teaching ideas in our course. This course intends to: 1) strengthen and deepen the elementary teacher’s understanding of basic concepts of landforms and landform analysis; 2) increase the K-6 teacher’s level of landform content knowledge and science principles; and 3) increase the K-6 teacher’s pedagogical skills in teaching science in general and landform science in particular. Offered Summer.

ERTH 527 Weather & Climate for Teachers: 3 Credits (3 Lec)
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: Course 527 or equivalent. The science of climate change is a complex subject that balances the physical record and scientific fact with politics, policy, and ethics. This course, specially designed for practicing science teachers at the upper middle to high school level, explores the science of climate change. Offered Summer
ERTH 592  Independent Study: 1-3 Credits (1 Other)
PREREQUISITE: Graduate standing, consent of instructor, approval of Department Head and Dean of Graduate Studies. Directed research and study on an individual basis. Repeatable up to 6 credits.

ERTH 594  Seminar: 1-4 Credits (1-4 Other)
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. Co-convened with ERTH 494. Offered Summer. Repeatable up to 4 credits.

ERTH 595  Historical Geology for Teachers: 3 Credits (1 Lec, 1 Lab, 1 Other)
The course will provide grade 7-12 science teachers with a rigorous overview of the evolution of the Earth and life and of the methods that geologists use to investigate the history of our planet. Offered Fall.

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

ERTH 598  Internship: 2-12 Credits (2 Other)
PREREQUISITE: Graduate standing, consent of instructor and approval of department head. 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.