

# Earth Sciences (ERTH)

## Earth Sciences (ERTH) Courses

### ERTH 1002 [0.5 credit]

#### **The Earth and Life Odyssey: A Journey Through Billions of Years**

Embark on a thrilling journey through Earth's epic history! Discover the groundbreaking events and powerful forces that shaped our planet, revealing the dramatic story behind the world we live in today.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 1004, ERTH 1006 (no longer offered), ERTH 1009 (no longer offered), ERTH 1010 (no longer offered) and ERTH 1011 (no longer offered).

Prerequisite(s): a 4U/M level in Advanced Functions and at least one of Biology, Chemistry, Earth and Space Sciences or Physics are recommended. This course is for students who are enrolled in the Faculty of Science.

Lectures three hours a week, a laboratory three hours per week, and a field excursion.

### ERTH 1004 [0.5 credit]

#### **Earth's Epic Tale: A Story Across Billions of Years**

Embark on a thrilling journey through Earth's epic history! Discover the groundbreaking events and powerful forces that shaped our planet, revealing the dramatic story behind the world we live in today.

Precludes additional credit for ERTH 1002, ERTH 1006 (no longer offered), ERTH 1009 (no longer offered), ERTH 1010 (no longer offered) and ERTH 1011 (no longer offered).

Prerequisite(s): a 4U/M level in Advanced Functions and at least one of Biology, Chemistry, Earth and Space Sciences or Physics are recommended. This course is for students who are not enrolled in the Faculty of Science except the Bachelor of Computer Science.

Lectures three hours a week.

### ERTH 2004 [0.5 credit]

#### **Maps, Satellites and the Geospatial Revolution**

Introduction to the creation and use of maps using a variety of geospatial tools to better understand and resolve physical, social and environmental problems. Overview of geomatics (cartography and map design, geographic information systems, GPS, remote sensing).

Also listed as GEOM 1004.

Precludes additional credit for GEOM 2004 (no longer offered).

Lectures and laboratory, four hours a week.

### ERTH 2012 [0.5 credit]

#### **Planet Hollywood**

Earth Science concepts and content portrayed in Hollywood films are sometimes accurate but more frequently misrepresented. This course will examine popular Hollywood films to critically evaluate the Earth Science concepts and content that they present and directly compare them to the actual science.

Online modules, bi-weekly film screenings and discussions four hours per week.

### ERTH 2102 [0.5 credit]

#### **Mineralogy to Petrology**

Chemical, optical and crystallographic properties of common rock-forming minerals, with introduction to common mineral assemblages of igneous, sedimentary, and metamorphic rocks.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 3202 (no longer offered).

Prerequisite(s): ERTH 1002, CHEM 1001, and CHEM 1002.

Lectures two hours a week and laboratory three hours a week.

### ERTH 2105 [0.5 credit]

#### **Geodynamics**

The structure, composition, and rheological properties of the Earth: lithosphere, mantle and core. Plate tectonics and its relation to geophysical fields, driving mechanisms, and processes at plate boundaries and in plate interiors.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 3805 (no longer offered).

Prerequisite(s): ERTH 1002 or GEOG 2013.

Lectures two hours a week and a laboratory three hours a week.

### ERTH 2106 [0.5 credit]

#### **Geochemistry**

This course looks at geochemical processes from deep Earth to surface environments, and the use of geochemical pathways in order to better understand the Earth's history.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 3003 (no longer offered).

Prerequisite(s): ERTH 1002, CHEM 1001 and CHEM 1002.

Lecture 1.5 hours per week, a laboratory three hours per week.

**ERTH 2312 [0.5 credit]****Paleontology**

Introduction to macrofossil and microfossil groups, their paleoenvironmental significance, and principles of evolutionary paleoecology.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 2316, GEOL 2301 (no longer offered) and GEOL 2306 (no longer offered).

Prerequisite(s): ERTH 1002 or GEOG 2013.

Lectures two hours a week and a laboratory three hours a week.

**ERTH 2314 [0.5 credit]****Sedimentation and Stratigraphy**

Origin of sediments and their transport, distribution, and primary structures; processes of sediment-to-rock transformation; spatial patterns; controls of stratigraphy; methods of correlation.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 2318 (no longer offered).

Prerequisite(s): ERTH 1002 or GEOG 2013.

Lectures three hours a week and a laboratory three hours a week.

**ERTH 2316 [0.5 credit]****Paleoecology**

Introduction to macrofossil and microfossil groups, their paleoenvironmental significance, and principles of evolutionary paleoecology.

Precludes additional credit for ERTH 2312. Not available for credit in B.Sc. Earth Sciences programs.

Lectures two hours a week.

**ERTH 2401 [0.5 credit]****Dinosaurs**

A general introduction to dinosaurs, their place in evolution, their social behaviour, the Mesozoic landscape and extinction theories.

Lectures three hours a week.

**ERTH 2402 [0.5 credit]****Climate Change: An Earth Sciences Perspective**

An exploration of the often dramatic climate changes that have occurred through earth history from a geological perspective, emphasizing the history of earth climates, geological causes of climate change and impact that rapid climate change has had on the biosphere.

Precludes additional credit for ERTH 2422.

Lectures three hours a week.

**ERTH 2403 [0.5 credit]****Introduction to Oceanography**

An environmental approach to understanding the oceans; introducing the physical and biological aspects of oceanography, marine resources and marine pollution.

Lectures three hours per week.

**ERTH 2404 [0.5 credit]****Engineering Geoscience**

Applications of the basic concepts of geology, earth materials and earth processes to practical engineering and environmental science. Topics include rock and soil mechanics, slope stability, hydrogeology, geological hazards, and site investigations. Overview of related geophysical methods.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 2414 (no longer offered), ERTH 1006 (no longer offered) and ERTH 1010 (no longer offered).

Prerequisite(s): completion of first year of any B.Eng. program.

Lectures three hours a week and a laboratory three hours a week.

**ERTH 2407 [0.5 credit]****Structural Geology**

Structures and deformation of earth materials. Topics include stress, strain, folding and faulting.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 3806 (no longer offered).

Prerequisite(s): ERTH 1002 and ERTH 2102.

Lecture three hours a week and a laboratory 3 hours a week.

**ERTH 2415 [0.5 credit]****Natural Disasters**

Physical characteristics and causes of natural disasters of geological origin such as volcanic eruptions, earthquakes, tsunamis, landslides, hurricanes and meteor impacts. Discussion on historical perspective, societal impact and mitigation strategies. Emphasis on Canadian case histories.

Precludes additional credit for ERTH 1003 (no longer offered).

Prerequisite(s): second-year standing in any degree program. With the exception of the Minor in Earth Sciences, available as a free elective only in any B.Sc. program, including Earth Sciences.

Lectures three hours a week.

**ERTH 2419 [0.5 credit]****On the Origin of Planets**

Origin and evolution of all planetary objects in the solar system. Topics include the geology of comets, asteroids, the terrestrial planets and rocky moons, Earth's formation and early evolution, ocean worlds, the search for exoplanets and detection of extraterrestrial life.

Lectures three hours a week.

**ERTH 2420 [0.5 credit]****UNESCO World Geoparks and Geoheritage**

Development of the geologic sciences and enhanced knowledge of the Earth and its history through the lens of inspiring and extraordinary global geological sites that have contributed significantly to science and culture.

Lectures three hours a week.

**ERTH 2421 [0.5 credit]****A Geologic Tour of the National Parks of North America**

An introduction to the geology of North America's National parks, the ultimate awe-inspiring educational experience, and how these parks collectively tell the story of the processes that have shaped the continent.

Lectures three hours a week.

**ERTH 2422 [0.5 credit]****Drivers of Climate Change through Geological Time**

A survey of Earth's 4.5-billion-year climate history, focusing on the use of geologic data to understand the drivers of climate change and their impact on the development of the lithosphere, hydrosphere, atmosphere, and biosphere. Course includes experiential learning assignments.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 2402.

Lecture three hours per week; also includes additional online synchronous/asynchronous experiential learning practicum.

**ERTH 2802 [0.5 credit]****Field Geology I**

Field analysis using geological, geophysical and computational methods leading to the interpretation of the origins of geological features and processes.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 2314 and ERTH 2407 and permission of the department.

Field work for two weeks off campus. A supplementary fee will apply.

**ERTH 3004 [0.5 credit]****Igneous Petrology**

Origins and evolution of igneous rocks through partial melting, crystallization, degassing, and assimilation of host rocks. Phase diagrams and classification schemes will be used to provide systematic tools for the description and interpretation of igneous rocks.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 2104 (no longer offered).

Prerequisite(s): ERTH 2102.

Lecture three hours per week, a laboratory three hours per week.

**ERTH 3111 [0.5 credit]****Vertebrate Evolution: Mammals, Reptiles, and Birds**

Evolution of mammals, reptiles and birds. Emphasis on surveying amniote diversity, and the origin of key amniote transformations, as evidenced by the fossil record.

Includes: Experiential Learning Activity

Also listed as BIOL 3111.

Prerequisite(s): ERTH 1002 or BIOL 2001.

Lectures two hours a week and a laboratory three hours a week.

**ERTH 3112 [0.5 credit]****Vertebrate Evolution: Fish and Amphibians**

Evolution of fish and amphibians. Emphasis on surveying fish and amphibian diversity, and the origin of key transformations of these groups, as evidenced by the fossil record.

Includes: Experiential Learning Activity

Also listed as BIOL 3112.

Prerequisite(s): ERTH 1002 or BIOL 2001.

Lectures two hours a week and a laboratory three hours a week.

**ERTH 3113 [0.5 credit]****Geology of Human Origins**

The origin and evolution of our species from geological, biological and cultural perspectives. The course traces human ancestry from our primate roots through time and changing environments, and explores controversies, frauds, and misperceptions.

Prerequisite(s): any 1000 or 2000 level Earth Sciences or Biology course.

Lectures three hours per week.

**ERTH 3114 [0.5 credit]****Evolution of Mammals, Reptiles and Birds**

Evolution of mammals, reptiles and birds. Emphasis on surveying amniote diversity, and the origin of key amniote transformations, as evidenced by the fossil record.

Precludes additional credit for ERTH 3111 and BIOL 3111.

Prerequisite(s): any 1000- or 2000-level Earth Sciences or Biology course.

Lectures two hours per week.

**ERTH 3115 [0.5 credit]****Evolution of Fish and Amphibians**

Evolution of fish and amphibians. Emphasis on surveying fish and amphibian diversity and the origin of key transformations of these groups, as evidenced by the fossil record.

Precludes additional credit for ERTH 3112 and BIOL 3112.

Prerequisite(s): any 1000- or 2000-level Earth Sciences or Biology course.

Lectures two hours per week.

**ERTH 3204 [0.5 credit]****Mineral Deposits**

Analysis and interpretation of the geological and geochemical processes responsible for mineral deposit genesis in a global context.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 2102 and ERTH 2106.

Lectures two hours and a laboratory three hours a week.

**ERTH 3205 [0.5 credit]****Physical Hydrogeology**

Principles of deep- to shallow fluid flow within the Earth's crust, and introduction to the exploration, development and management of groundwater as a global resource.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 1002 or GEOG 2013.

Lecture three hours a week and a laboratory three hours a week.

**ERTH 3207 [0.5 credit]****Metamorphic Petrology and Processes**

Genesis of metamorphic rocks as determined from field, petrographic and geochemical data.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 3202 (no longer offered).

Prerequisite(s): ERTH 2102.

Lectures two hours a week, a laboratory three hours a week and a field excursion.

**ERTH 3405 [0.5 credit]****Geophysical Methods**

An introduction to the tools of applied geophysics including seismology, electrical, magnetic, and gravitational surveying methods.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 2405 (no longer offered).

Prerequisite(s): ERTH 2105.

Lecture two hours a week and a laboratory three hours a week.

**ERTH 3703 [0.5 credit]****Isotope Geochemistry and Geochronology**

This course looks at stable and radiogenic isotope systematics applied to different Earth environments. Students will delve into geochronological techniques and their applications, and apply the principles of elemental and isotopic fractionation to investigate several geological processes.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 4803 (no longer offered).

Prerequisite(s): ERTH 2106.

Lecture 1.5 hours per week, a laboratory three hours per week.

**ERTH 3999 [0.0 credit]****Co-operative Work Term**

Includes: Experiential Learning Activity

**ERTH 4003 [0.5 credit]****Directed Studies in Earth Sciences**

One or more projects involving at least 15 days field and/or laboratory research, not related to thesis research.

Assessment based on written reports and an oral presentation. Expenses for long-distance travel are borne by the student.

Includes: Experiential Learning Activity

Prerequisite(s): fourth-year standing in any B.Sc. Hons. or Combined Hons. program in Earth Sciences.

Schedule to be arranged.

**ERTH 4004 [0.5 credit]****Special Topics in Earth Sciences**

Field, laboratory or literature research, not related to thesis research. Assessment based on written reports and an oral presentation. Expenses for travel are borne by the student.

Prerequisite(s): fourth-year standing in any B.Sc. Hons. or Combined Hons. program in Earth Sciences. Major CGPA 8.5 or higher at time of registration for the course.

Schedule to be arranged.

**ERTH 4006 [0.5 credit]****Field Environmental Geobiology**

Exploration of the relationship between micro- and macro-ecological and evolutionary processes and the Earth's physical and chemical environment. Paleobiology and evolutionary ecology in the context of paleoceanography, paleolimnology and/or paleoclimatology. Will include one or two weeks of field based instruction with costs borne by student.

Prerequisite(s): 2nd year standing in a Faculty of Science program and permission of the Department.

Field work off campus.

**ERTH 4007 [0.5 credit]****Evolutionary Developmental Paleobiology**

This course explores the mechanistic basis of organismic evolution from genetic, morphogenetic and epigenetic perspectives, within a phylogenetic context of living and extinct vertebrates.

Includes: Experiential Learning Activity

Precludes additional credit for BIOL 4007.

Prerequisite(s): ERTH 2312 or BIOL 2001, and BIOL 2104.

Lectures or seminars three hours per week.

**ERTH 4008 [0.5 credit]****Topics in Paleobiology and Evolution**

This multidisciplinary seminar course investigates various topics in paleobiology, paleoecology and evolutionary theory.

Prerequisite(s): 3rd year standing in any Faculty of Science program.

Lectures and seminar discussion, three hours per week

**ERTH 4107 [0.5 credit]****Geotechnical Mechanics**

Soil composition and soil classification. Soil properties, compaction, seepage and permeability. Concepts of pore water pressure, capillary pressure and hydraulic head. Principle of effective stress, stress-deformation and strength characteristics of soils, consolidation, stress distribution with soils, and settlement. Laboratory testing.

Includes: Experiential Learning Activity

Also listed as CIVE 3208.

Prerequisite(s): ERTH 3405.

Lectures three hours a week, laboratory three hours alternate weeks.

**ERTH 4206 [0.5 credit]****Contaminant and Remediation Hydrogeology**

Geochemical and physical processes controlling contaminant release, migration, and fate in groundwater along with the processes and techniques used for contaminant mitigation and remediation. Examples will include organic and inorganic contaminants in a variety of settings.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 2106 and ERTH 3205.

Lectures three hours per week and a laboratory three hours per week.

**ERTH 4209 [0.5 credit]****Mineral Exploration Field Geology**

Introduction to the essentials of conducting geological mapping campaign in the Canadian Shield in a field area that has seen considerable industry exploration for volcanogenic massive sulfide mineralization. Activities include outcrop and trench mapping, strain analysis, interpretation of geophysical data, drilling proposals, report writing.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 3209.

Prerequisite(s): ERTH 2407 or ERTH 3004 and ERTH 3207.

Field work for two weeks off-campus. A supplementary fee will apply.

**ERTH 4302 [0.5 credit]****Frozen Earth: Unveiling the Snowball Earth Catastrophe**

Discover how icy cataclysms shaped our planet through Earth's most extreme climate event: Snowball Earth!

We will explore this theory's origins, examine compelling geologic and geochemical evidence, and dive into topics such as glacial sedimentology, the carbon cycle, evolution, and more on this thrilling adventure.

Prerequisite(s): ERTH 2314 or permission of the department.

Lectures three hours per week.

**ERTH 4305 [0.5 credit]****Advanced Sedimentary Geology and Earth History**

The origin, composition and diagenesis of sedimentary rocks throughout Earth history. Study of modern and ancient sedimentary systems; development of facies models; petrographic and geochemical analysis of sedimentary rocks.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 2314.

Lecture two hours a week and a laboratory three hours a week.

**ERTH 4507 [0.5 credit]****Advanced Petrology**

Analysis of the physical and chemical conditions, rock-forming processes, as well as the tectonic settings, that control the formation of different rock types. May include one to two weeks of field-based instruction, with costs borne by the student.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 3207.

Field excursions, lectures or seminars three hours per week.



**ERTH 4801 [0.5 credit]****Physics of the Earth**

The physical properties of the solid Earth. Gravitational, magnetic and palaeomagnetic fields; seismology and earthquake occurrence; heat flow and thermal history. Geodynamic processes.

Prerequisite(s): ERTH 3405.

Also offered at the graduate level, with different requirements, as ERTH 5701, for which additional credit is precluded.

Lectures three hours a week.

**ERTH 4807 [0.5 credit]****Field Geology II**

Field camp integrating advanced field, theory and experimental data. Assessment is based on reports, seminars, and oral examinations. Part of the cost is borne by the student. Departmental funding assistance is available for only one 4000-level field course per student.

Includes: Experiential Learning Activity

Prerequisite(s): completion of the third-year Earth Sciences course requirements and permission of the Department. A supplementary fee will apply.

Field work off campus.

**ERTH 4808 [0.5 credit]****Vertebrate Paleontology Field Camp**

Field camp extends the student's vertebrate paleontological knowledge by integrating field, theory, and experimental data. Assessment based on written reports and seminars. Part of the cost is borne by the student. Departmental funding assistance is available for only one 4000-level field course per student.

Includes: Experiential Learning Activity

Prerequisite(s): ERTH 3111 or ERTH 3112, and ERTH 3113. A Major CGPA of 8.5 or higher and permission of the department. This course is only available to Undergraduate students enrolled in the BSc Earth Sciences with concentration in Vertebrate Paleontology and Paleoecology Honours program.

Field work for two weeks off campus. A supplementary fee will apply.

**ERTH 4815 [0.5 credit]****Natural Hazards in Canada**

Overview of the main natural hazards (such as floods, landslides, forest fires, earthquakes) and severe weather phenomena (such as ice storms, hail, tornadoes) in the Canadian environment. Risk of catastrophic events and their impact on society and infrastructure.

Prerequisite(s): third-year standing in earth science programs or permission of the department.

Also offered at the graduate level, with different requirements, as ERTH 5215 and IPIS 5505, for which additional credit is precluded.

Lectures three hours a week.

**ERTH 4908 [1.0 credit]****Honours Thesis**

Independent studies. Requires prior written approval of a topic from a supervisor and the course co-ordinator. Oral and written proposal, progress and defence reports are required.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 4909, ERTH 4910 (no longer offered).

Prerequisite(s): restricted to B.Sc. Honours and Combined Honours ERTH programs. Major CGPA 8.5 or higher at time of registration for the course.

**ERTH 4909 [0.5 credit]****Research in Earth Sciences**

Understanding research methods, data interpretation and presentation, through readings, seminars and/or laboratory projects related to a topic selected by the student with approval of a faculty advisor.

Includes: Experiential Learning Activity

Precludes additional credit for ERTH 4908, ERTH 4910 (no longer offered).

Prerequisite(s): restricted to B.Sc. Honours and Combined Honours Earth Sciences programs.