

# Earth Sciences (ERTH)

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## Earth Sciences (ERTH) Courses

### Earth Sciences

#### Faculty of Science

#### **ERTH 1006 [0.5 credit]**

##### **Exploring Planet Earth**

Origin of the Earth, concepts of geological time, and exploration of the interaction and duration of geological processes that shape the surface to deep interior of our planet, the climate, and formation of rocks and earth resources.

Precludes additional credit for ERTH 1001 (no longer offered) and ERTH 1010.

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 a week, and a field excursion.

#### **ERTH 1009 [0.5 credit]**

##### **The Earth System Through Time**

Earth's changing patterns of continent and ocean basin distribution related to plate tectonics; resulting change in global sea level, sedimentation, paleoclimates and life on Earth.

Precludes additional credit for GEOL 1008 (no longer offered) and ERTH 1011.

Prerequisite(s): ERTH 1006. This course is for students who are enrolled in the Faculty of Science.

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

#### **ERTH 1010 [0.5 credit]**

##### **Our Dynamic Planet Earth**

Origin of the Earth, concepts of geological time, and exploration of the interaction and duration of geological processes that shape the surface to deep interior of our planet, the climate, and formation of rocks and earth resources.

Precludes additional credit for ERTH 1001 (no longer offered) and ERTH 1006.

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.

Lectures three hours a week.

#### **ERTH 1011 [0.5 credit]**

##### **Evolution of the Earth**

Earth's changing patterns of continent and ocean basin distribution related to plate tectonics; resulting change in global sea level, sedimentation, paleoclimates and life on Earth.

Precludes additional credit for GEOL 1008 (no longer offered) and ERTH 1009.

Prerequisite(s): a 4U/M level in Advanced Functions and at least one of Biology, Chemistry, Earth and Space Sciences or Physics are recommended; ERTH 1010 is normally taken prior to this course. This course is for students who are not enrolled in the Faculty of Science. Lectures three hours a week.

#### **ERTH 2001 [0.5 credit]**

##### **Co-operative Work Term Report 1**

This course provides practical experience for students enrolled in the Co-operative Option. To receive course credit a student must receive satisfactory evaluations from their work term employer. Written and oral reports describing the work term project will be required.

Prerequisite(s): registration in the Earth Sciences Co-operative Option and permission of the Department. Four-month work term.

#### **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.

Precludes additional credit for ERTH 3202.

Prerequisite(s): ERTH 1001 (no longer offered) or ERTH 1006 and (ERTH 1009 or GEOG 2013) and CHEM 1002 or CHEM 1006.

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

#### **ERTH 2104 [0.5 credit]**

##### **Igneous Systems, Geochemistry and Processes**

The sources and magmatic evolution of volcanic and plutonic rocks systems, with emphasis on geochemical, mineralogical, and textural characteristics, and relations to igneous processes.

Precludes additional credit for ERTH 3202

Prerequisite(s): ERTH 2102.

Lectures two hours a week, laboratory three hours a week, tutorial one hour per week, and a field excursion.

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

Prerequisite(s): ERTH 1001 (no longer offered) or ERTH 1006 and (ERTH 1009 or GEOG 2013).

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

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

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

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

Prerequisite(s): ERTH 1001 (no longer offered) or ERTH 1006 and ERTH 1009.

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 and controls of stratigraphy and methods of correlation.

Prerequisite(s): ERTH 1001 (no longer offered) or ERTH 1006 and (ERTH 1009 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.

Prerequisite(s): ERTH 1001 (no longer offered) or ERTH 1006 and ERTH 1009. Priority given to students in the Minor in Earth Sciences. Not available for credit in B.Sc. Earth Sciences programs.

Lectures three hours a week.

**ERTH 2318 [0.5 credit]****Sedimentology**

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

Precludes additional credit for ERTH 2314.

Prerequisite(s): ERTH 1001 (no longer offered) or ERTH 1006 and ERTH 1009 or ERTH 1007 (no longer offered).

Priority given to students in the Minor in Earth Sciences. Not available for credit in B.Sc. Earth Sciences programs. Lectures three hours a week.

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

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

With the exception of the Minor in Earth Sciences, and Concentration in Vertebrate Paleontology and Paleoecology, students in Earth Sciences programs may use this course only as a free elective.

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.

With the exception of the Minor in Earth Sciences, students in Earth Sciences programs may use this course only as a free elective.

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.

With the exception of the Minor in Earth Sciences, students in Earth Sciences programs may use this course only as a free elective.

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.

Precludes additional credit for ERTH 2414 and ERTH 1006.

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

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

**ERTH 2406 [0.5 credit]****Geology and Map Interpretation**

Analysis and interpretation of geological features and processes using rocks, maps and cross sections.

Introduction to computational methods.

Prerequisite(s): ERTH 2102 and GEOM 2007 (may be taken concurrently).

Lectures two hours a week and a laboratory three 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 2802 [0.5 credit]****Field Geology**

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

Prerequisite(s): ERTH 2406 and permission of the department.

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

**ERTH 3001 [0.5 credit]****Co-operative Work Term Report 2**

This course provides practical experience for students enrolled in the Co-operative Option. To receive course credit a student must receive satisfactory evaluations from their work term employer. Written and oral reports describing the work term project will be required.

Prerequisite(s): registration in the Earth Sciences Co-operative Option and permission of the Department.

Four-month work term.

**ERTH 3002 [0.5 credit]****Gemology**

Gemstones including their physical and chemical properties, geological formation and geographic occurrence. Introduction to gemological laboratory methods.

Prerequisite(s): ERTH 2102.

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

**ERTH 3003 [0.5 credit]****Geochemistry and Geochronology**

Geochemical processes within crustal to surface environments, and use of isotopic variations of certain elements to define geochronological frameworks and geochemical pathways to better understand the earth's history.

Precludes additional credit for ERTH 2101 (no longer offered).

Prerequisite(s): ERTH 2102.

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

**ERTH 3111 [0.5 credit]****Vertebrate Paleontology I: Mammalian Paleontology and Evolution**

An introduction to the use of fossil evidence for studying the evolution of mammals, including the application of anatomy, functional morphology, biogeography, paleoecology, and systematics.

Prerequisite(s): BIOL 2001 (may be taken concurrently).

Lectures two hours a week and a laboratory three hours a week. May be offered in alternate years.

**ERTH 3112 [0.5 credit]****Paleontology and Evolution of Lower Vertebrates**

An introduction to fossil vertebrates, including fish, amphibians and reptiles, concentrating on anatomy, functional morphology, origins, evolution and systematics; and, transitions into new adaptive zones and associated environmental factors.

Prerequisite(s): BIOL 2001 (may be taken concurrently).

Lectures two hours a week and a laboratory three hours a week. May be offered in alternate years.

**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 course.

Lectures three hours per week. May be offered in alternate years.

**ERTH 3203 [0.5 credit]****Applied Sedimentology**

Field-based analysis of sedimentary processes as developed in modern and preserved in ancient geological environments.

This course occurs off campus over a 10-day period. A supplementary fee may apply.

Precludes additional credit for ERTH 3201 (no longer offered).

Prerequisite(s): ERTH 2102, ERTH 2104, ERTH 2105, ERTH 2312, ERTH 2314, ERTH 2406, ERTH 2802 and a second-year Earth Sciences average of 8.00 and permission of the department.

**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.

Prerequisite(s): ERTH 2104.

Lectures and laboratory five 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.

Prerequisite(s): ERTH 1006 and (ERTH 1009 or GEOG 2013).

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

**ERTH 3206 [0.5 credit]****Oceanography: Its Modern and Geologic Records**

Composition and movement of the oceans, processes of sediment production and its distribution, ocean/climate interactions, geological proxies for ancient oceanographic conditions, and cyclic sedimentary and geochemical patterns.

Precludes additional credit for ERTH 3208.

Prerequisite(s): ERTH 2314.

Lectures 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.

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

Prerequisite(s): ERTH 2104.

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

**ERTH 3208 [0.5 credit]****Oceanography: An Earth Sciences Perspective**

The principal geological, physical, chemical and biological oceanographic processes and their interaction in today's oceans in comparison to a succession of critical stages of oceanographic development through geologic time.

Precludes additional credit for ERTH 3206.

Prerequisite(s): ERTH 1006 and ERTH 1007 (no longer offered) or ERTH 1009 or ERTH 2318.

Lectures three hours a week.

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

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

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 3806 [0.5 credit]****Structural Geology**

Structures and deformational processes in a variety of crustal settings. Applications to geological engineering and mineral and petroleum exploration.

Prerequisite(s): ERTH 2105 and ERTH 2406.

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

**ERTH 3999 [0.0 credit]****Co-operative Work Term****ERTH 4001 [0.5 credit]****Co-operative Work Term Report 3**

This course provides practical experience for students enrolled in the Co-operative Option. To receive course credit a student must receive satisfactory evaluations from their work term employer. Written and oral reports describing the work term project will be required.

Prerequisite(s): registration in the Earth Sciences Co-operative Option and permission of the Department.

Four-month work term.

**ERTH 4003 [0.5 credit]****Directed Studies in Geology**

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.

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

Schedule to be arranged.

**ERTH 4005 [0.5 credit]****Micropaleontology**

Paleoecological and biostratigraphic significance, and evolutionary history of marine and freshwater microorganisms.

Prerequisite(s): ERTH 2312.

Lectures, seminars and/or laboratory five hours a 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. Also listed as CIVE 3208.

Prerequisite(s): ERTH 2406 or equivalent and third-year registration, or permission of the Department.

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

**ERTH 4303 [0.5 credit]****Resources of the Earth**

Earth's resources: where they occur, how they are concentrated, how they are extracted and used, and how human exploitation of natural resources impacts on the environment.

Prerequisite(s): third-year standing in any degree program.

Lectures three hours a week.

**ERTH 4305 [0.5 credit]****Carbonate Sedimentology**

The origin, composition and diagenesis of carbonate rocks. Study of modern and ancient platform systems; development of facies models; petrographic and geochemical analysis of limestones and dolostones.

Prerequisite(s): ERTH 3203 or ERTH 3206.

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

**ERTH 4306 [0.5 credit]****Resource Basin Analysis**

Surface and subsurface geological and geophysical techniques used to define the distribution and origin of geological basins, the architecture of basin fill, and characterize the distribution of water, petroleum and mineral resources.

Prerequisite(s): EARTH 3203 or EARTH 3206, EARTH 3205, and EARTH 3806.

Lectures, seminars and laboratory five hours a week.

**ERTH 4402 [0.5 credit]****Structural Geology**

A study of the structural evolution of mountain belts, with emphasis on field methods.

Prerequisite(s): EARTH 3806.

Lectures, seminars and laboratory five hours a week.

**ERTH 4403 [0.5 credit]****Tectonic Evolution of Canada**

Geologic evolution of Canada focusing on geological styles and tectonic processes of Archean cratons, Proterozoic and Phanerozoic orogenic belts.

Prerequisite(s): EARTH 3806.

Lectures and seminars three hours a week.

**ERTH 4504 [0.5 credit]****Advanced Igneous Petrology**

Volcanology, petrology, mineralogy and geochemistry of igneous rocks and their tectonic setting; includes one to two weeks of field-based instruction, costs borne by student.

Prerequisite(s): EARTH 2104.

Field excursions, seminars three hours a week.

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

Introduction to the quantitative analysis of pressure-temperature-time trajectories and rock-forming processes during metamorphic petrogenesis.

Prerequisite(s): EARTH 3207.

Lectures two hours a week, laboratories two hours a week, seminars one hour a week.

**ERTH 4707 [0.5 credit]****Engineering Seismology**

Seismological topics with engineering applications. Characterization of seismicity and seismic sources (areas and faults). Seismic hazard analysis. Empirical and theoretical modeling of strong ground motion in time and frequency domains.

Prerequisite(s): one of MATH 1007 or MATH 1004, and one of MATH 1107 or MATH 1104, STAT 2507, and one of EARTH 2404, EARTH 2406 or EARTH 3805.

Also offered at the graduate level, with different requirements, as EARTH 5707, for which additional credit is precluded.

Lectures three hours a 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): EARTH 2105.

Also offered at the graduate level, with different requirements, as EARTH 5171, for which additional credit is precluded.

Lectures three hours a week.

**ERTH 4803 [0.5 credit]****Advanced Isotope Geology**

Chemical evolution of the Earth, meteorites; mantle and crustal evolution; radiogenic and stable isotopes; noble gas isotopes; applications to mineral deposits; environmental applications.

Prerequisite(s): EARTH 3003.

Also offered at the graduate level, with different requirements, as EARTH 5609, for which additional credit is precluded.

Lectures three hours per week, seminars one hour per week.

**ERTH 4804 [0.5 credit]****Exploration Geophysics**

Application of geophysical methods to explore for petroleum and mineral resources, with emphasis on seismic and electromagnetic methods. Case histories illustrate the concepts.

Prerequisite(s): EARTH 3405.

Lectures and laboratories five hours per week.

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

Two-week field camp designed to extend the student's geological knowledge by integrating advanced field, theory and experimental data. Assessment based on written reports, seminars, and oral examinations. Part of the cost is borne by the student. Departmental funding assistance is available for only one of EARTH 4807 and EARTH 4808.

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

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

Two-week field camp at Dinosaur Provincial Park (Alberta) designed to extend 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 of EARTH 4807 and EARTH 4808.

Prerequisite(s): completion of third-year course requirements within the Vertebrate Paleontology concentration, and permission of the Department.

**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.

Precludes additional credit for ERTH 4909.

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.

Precludes additional credit for ERTH 4908.

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

**Summer session:** some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at [central.carleton.ca](http://central.carleton.ca)

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at [central.carleton.ca](http://central.carleton.ca)