

## **ERTH 1006: Exploring Planet Earth**

### **Fall 2019 Course Outline**

Why should you want to take a course in Earth Science? Here's why: nearly everything that we do is connected in some way to the physical Earth; its lands, oceans, atmosphere, plants and animals. The materials used for our homes and offices, the clothes that we wear, cellphones and computers, our sources of energy, our drinking water, the air that we breathe, and the food that we eat, are all in some way derived from our planet. The Earth Sciences offer an integrated and interdisciplinary approach to understanding Earth, and apply knowledge from biology, chemistry, physics, ecology, mathematics and computer science to tackle complex issues. If we wish to maintain and improve the quality of life on Earth, as its population approaches 8 billion people, then we are required to understand and appreciate the complex processes that control our planet.

Earth Science benefits everyone! Sedimentologists, paleontologists and ocean geochemists study climate patterns of the past in order to understand the causes of our current global warming event. Seismologists monitor earthquake activity in order to evaluate earthquake risk in populated areas and understand how and why faults occur. Hydrologists and geochemists study water quality and the availability of clean, long-term water sources. Volcanologists investigate the current and past activity of volcanoes to determine the risk to local populations that inhabit the fertile slopes of these edifices and to explore how the interior of the Earth melts to form the lavas erupted at volcanoes. Paleontologists study the record of life on Earth recorded as fossils in rocks, providing fundamental information on the condition of the planet and its effect on life through time. Resource specialists focus on finding and extracting the raw materials needed for modern industry and society, such as petroleum products, iron, copper, zinc, silicon, and talc. Understanding Earth Science empowers you to think globally and act locally. Only if you understand the Earth system can you make informed decisions about issues that impact our daily lives. Should I buy a house built along the shore of a river or at the top of a steep slope? If I am buying a car, should I get a diesel, gasoline, hybrid or electric vehicle? Where will the electrical power of the future come from? Why should I recycle plastic containers? If we have so much water in Canada, why are sources of drinking water difficult to find? Why is the mining of oil sands in Alberta such a controversial issue?

In December 2004, a huge earthquake ripped through the northwestern part of Indonesia, causing a tsunami (commonly but incorrectly called a tidal wave) that inundated the shores of Thailand, Sumatra, and India, among other countries. Tourists and local inhabitants alike ran to the beaches as the water receded from the shore just prior to the arrival of the 10-metre high wave. Ignorance of the fact that sea level drops locally in advance of a tsunami cost thousands of people their lives with the tsunami ultimately resulting in >225,000 fatalities. Ignorance of how the Earth works is the norm in North America and elsewhere in the world, placing most of us at risk. The more recent 2011 earthquake and tsunami at Sendai, Japan, further shows how humans do not prepare for the worst possible event. The tsunami resulted in the destruction of a nuclear power plant and the spread of radioactive particles into the environment which was completely preventable.

This course will provide you with a broad overview of the Earth system, giving you a clear view of how the lithosphere, hydrosphere, atmosphere and biosphere all interact. We will discuss the origin of the Solar System, the Earth and Moon, and how meteorites retain a record of the composition of the early Earth and planets; the Earth as a layered planet; geologic time and radiometric dating of rocks and minerals; minerals and how they form; the theories of continental drift, seafloor spreading and plate tectonics, or "Why our Planet is Mobile"; rocks, including the major igneous, sedimentary and metamorphic rock types; the physical properties of the Earth, including magnetism, gravity and heat flow; earth resources, including water, metals, and energy, their extent and limitations, and potential resources of the future; and finally the geology of Canada.

### Course Pre-requisites:

This course is for students who are enrolled in the Faculty of Science.

### Course Evaluation:

The course includes three major components. Instruction consists of three lecture hours per week, either in-class (A section) or via CUOL (T section: live stream during lecture time, MW 4:35-5:55 pm, video in Loeb D299, or Video-On-Demand). In addition, all students must register for a weekly laboratory section. *THIS COURSE IS NOT OFFERED AS A LECTURE-ONLY COURSE.* Labs are only offered on-campus, so all students must be able to come in to Carleton for their lab period. A passing grade must be achieved in the lab to complete the course. Finally, all students must attend a compulsory field trip around the Ottawa area (further details below).

<b>Lecture Midterm Exam</b>	<b>20%</b>
<b>Lecture Final Exam</b>	<b>25%</b>
<b>Ottawa Geology Fieldtrip</b>	<b>5%</b>
<b>Lab Quizzes</b>	<b>10%</b>
<b>Lab Exercises</b>	<b>20%</b>
<b>Lab Practical Exam</b>	<b>20%</b>

#### Grading Scale:

A+	90-100%	C	63-66%
A	85-89%	C-	60-62%
A-	80-84%	D+	57-59%
B+	77-79%	D	53-56%
B	73-76%	D-	50-52%
B-	70-72%	F	<50%
C+	67-69%		

#### Class Schedule

Lecture Time:	MW 4:35 pm – 5:55 pm
Lecture Location:	1006A in SC 103 1006T streaming on CUOL
Lab Time:	Consult your schedule
Lab Location:	HP 2110
Office Hours:	TR 1-2 pm via Big Blue Button; W 1-2 pm in office

#### Instructor

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### Ottawa Geology Fieldtrip:

The **compulsory Ottawa Geology fieldtrip** will be held on Saturday, October 5th from 8:30 am to 4:00 pm. Additional details will be provided in lectures.

### Exams:

Since some students are taking this course through CUOL, the lecture midterm exam will be held **OUTSIDE OF CLASS TIME**, on Saturday November 2<sup>nd</sup> from 2:30 – 4:30 pm. The final exam will be scheduled during the December exam period.

### Required Course Materials:

*Textbook:* Marshak, Earth: Portrait of a Planet 6<sup>th</sup> ed. W. W. Norton & Co, 2008 ISBN: 978-0393640137

Paper and digital versions are available in the Carleton University Bookstore.

*Laboratory Manual:* Available as a CoursePack at the Sciences Stores (Steacie 118).

*Required Laboratory Tools:* Mineral Identification Kit, Hand Lens, Grain Size Card available at Science Stores.

**Learning Outcomes:**

By the end of the course, each successful student will acquire the following skills and knowledge sets in the lecture and laboratory sessions:

- Each student will demonstrate an understanding of the process of Earth formation and differentiation, the internal structure of Earth, and the origin of meteorites.
- Each student will demonstrate the ability to identify and characterize fundamental Earth materials, including minerals and rocks, and to understand the physical, chemical and biological processes by which they formed.
- Each student will demonstrate a knowledge of how faults form, why motion on faults produces energy, the links between energy, seismic waves and earthquakes, and how seismic waves are used to investigate Earth's internal structure.
- Each student will demonstrate an understanding of gravity, magnetism and heat flow on Earth, why the Earth's gravitational and magnetic fields vary over the Earth's surface, and why these geophysical properties are useful in describing geological structures in the crust, mantle and core.
- Each student will demonstrate an understanding of the theories of continental drift and plate tectonics, the geophysical evidence supporting plate tectonics, and be able to describe how plate tectonics operates.
- Each student will demonstrate an understanding about Earth's natural systems (lithosphere, atmosphere, and hydrosphere) and its resources, and how resources impact the economy of Canada.
- Each Student will demonstrate an understanding of the use and interpretation of topographic and geological maps.

**Conflicts with Course Requirements:**

Students with conflicts for **ANY** examination or the field trip must have a note from an employer or a medical certificate (see below) in order to write the exam at another date or qualify for a fieldtrip make-up assignment. Unless caused by illness, all conflicts **MUST** be reported to the instructor **PRIOR** to the exam date. If a lab is missed, a student may make it up in another lab section during that week without requiring a medical certificate **HOWEVER** permission from the lab coordinator is required.

No outside study aids (calculators, notes) will be allowed for any lecture-based exams. Any materials required for the lecture-based exams will be provided by the instructor. Details of the lab practical exam will be communicated in your laboratory sessions.

**Student Accommodation Processes:***Pregnancy obligation:*

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: <http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>

*Religious obligation:*

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: <http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>

*Academic Accommodations for Students with Disabilities:*

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at <https://carleton.ca/pmc/> or 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. Contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). *After requesting*

accommodation from PMC, contact and/or meet with your instructor directly as soon as possible to ensure accommodation arrangements are made.

**Survivors of Sexual Violence:**

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and its survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <http://carleton.ca/sexual-violence-support>

**Accommodation for Student Activities:**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

<https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

**For more information on academic accommodation, please contact the departmental administrator or visit:**

<https://students.carleton.ca/course-outline/>

**Plagiarism:**

Plagiarism is presenting, whether intentionally or not, the ideas, expression of ideas, or work of others as one's own. Plagiarism includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to: books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, art works, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, and material on the internet. This includes copying of material from websites or other publications that is incorporated into assignments, reports, or other submissions for grading. Borrowing someone else's answers, unauthorized possession of tests or answers to tests, or possession of material designed in answering exam questions, are all subject to university policy regarding instructional offences. Academic dishonesty, in whatever form, is destructive to the values of the university, and risks harming the university's reputation as place of learning and innovation. Furthermore, it is unfair and discouraging to those students who pursue their studies honestly. Additional details regarding the Carleton University Academic Integrity policy: <http://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf>

**Medical Certificates:**

The documentation from your licensed health care professional must indicate that you were examined and diagnosed at the time of the illness and/or injury, *not after the fact*. A medical statement that merely confirms a report of illness made by you is not acceptable. A completed Medical Certificate ([http://carleton.ca/registrar/wp-content/uploads/med\\_cert.pdf](http://carleton.ca/registrar/wp-content/uploads/med_cert.pdf)) must also clearly indicate that the problem was serious enough to have interfered with academic work, and, where appropriate, the ability to make suitable decisions about how best to address the impact on your studies. Only original medical documentation is acceptable and the health care professional's office may be contacted to verify the completion of the form.

**Course Behavior/Expectations:**

I expect your course behavior to reflect respect for all members of the course at all times. You should be prepared to participate in classroom activities, ask questions and answer questions in class and lab. *Personal electronic devices should not be distracting you or your classmates during lecture, lab or during field trips.* Please turn off all personal electronic devices during lectures. If you will be using a laptop or other device to take notes during class please sit in the front rows of the classroom. Outside of scheduled lecture and lab times, you are expected to spend 5-6 hours per week on this course with lecture and lab readings, quizzes, studying, etc.

**Fall 2019 Laboratory Schedule**

<b>Lab</b>	<b>Date</b>	<b>Topic</b>	<b>Weight (%)</b>
	<b>09/03-09/06</b>	<b>No Labs</b>	
1	09/10-09/13	Understanding Scalar Quantities in Earth Science	0
2	09/17-09/20	Physical Mineralogy	1
3	09/24-09/27	Igneous Rocks	1
4	10/01-10/04	Sedimentary Rocks	1
5	10/08-10/11	Geology of Hog's Back Park	1
6	10/15-10/18	Metamorphic Rocks	1
	<b>10/22-10-25</b>	<b>Fall Break (to prepare for the lab exam)</b>	
	<b>10/29-11/01</b>	<b>Lab Exam</b>	<b>20</b>
7	11/05-11/08	Introduction to Topographic Maps & Aerial Imagery	3
8	11/12-11/15	Geologic Time	3
9	11/19-11/22	Introduction to Geologic Maps and Cross-sections	3
10	11/26-11/29	Introduction to Earthquakes and Seismicity	3
11	12/03-12/06	Characteristics of the Ocean Floor & Plate Tectonics	3

### Course Outline (*TENTATIVE SCHEDULE ONLY*)

Date	Topic	Textbook Readings
<b>Week 1</b>		
<b>09/02</b>	<b><i>Labour Day – No lecture</i></b>	
09/04	Course introduction; Universe and Solar System	Chapter 1
<b>Week 2</b>		
09/09	Earth formation and geochronology	Chapter 1, Chapter 12
09/11	Physical mineralogy	Chapter 5
<b>Week 3</b>		
09/16	Physical mineralogy; The Rock Cycle	Chapter 5, Interludes A & C
09/18	Igneous rocks and volcanic hazards	Chapters 6 & 9
<b>Week 4</b>		
09/23	Igneous rocks and volcanic hazards	Chapters 6 & 9
09/25	Weathering, erosion and sedimentary rocks	Chapter 7
<b>Week 5</b>		
09/30	Weathering, erosion and sedimentary rocks	Chapter 7
10/02	Metamorphic rocks	Chapter 8
<b>10/05</b>	<b><i>Saturday Fieldtrip – Ottawa Geology</i></b>	<b><i>8:30 am – 4:00 pm</i></b>
<b>Week 6</b>		
10/07	Earth's interior; Seismology	Chapters 2 & 10, Interlude D
10/09	Seismology; Earthquakes	Chapter 10
<b>Week 7</b>		
<b>10/14</b>	<b><i>Thanksgiving – No lecture</i></b>	
10/16	Earth's gravity and heat flow	Interlude D, Boxes 1.4 & 2.3
<b>Week 8</b>		
<b>10/21-10/25</b>	<b><i>Fall Study Break</i></b>	
<b>Week 9</b>		
10/28	Geomagnetism	Interlude D, Chapters 2 & 3
10/30	Plate tectonics	Chapters 3 & 4
<b>11/02</b>	<b><i>Lecture Midterm Exam 2:30 – 4:30 pm</i></b>	
<b>Week 10</b>		
11/04	Plate tectonics	Chapters 3 & 4
11/06	Deformation and mountain building	Chapter 11
<b>Week 11</b>		
11/11	Deformation and mountain building	Chapter 11
11/13	The Hydrologic Cycle and Groundwater	Interlude F, Chapter 19
<b>Week 12</b>		
11/18	Rivers and flooding	Chapter 17
11/20	Energy resources	Chapter 14
<b>Week 13</b>		
11/25	Mineral resources	Chapter 15
11/27	Geology of Canada	Chapter 13, cuLearn
<b>Week 14</b>		
12/02	Geology of Canada	Chapter 13, cuLearn
12/04	Careers in Earth Sciences and Review	