

ERTH 1006: Exploring Planet Earth Summer 2022 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 intended for students who are enrolled in the Faculty of Science.

Course Evaluation:

There are three main components to the course including lecture modules, lab exercises and a virtual fieldtrip. These components are further outlined below with specific details posted on Brightspace and discussed in labs. Instruction will consist of asynchronous online lectures posted on Brightspace. Labs and lecture exams are only offered **ONLY** on-campus, so all students must be able to come in to Carleton for these components. A passing grade must be achieved in the lab to complete the course.

Lecture Midterm Exam	15%
Lecture Final Exam	20%
Fieldtrip	5%
Lecture Quizzes	10%
Lab Exercises	30%
Lab Practical Exam	20%

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: Asynchronous Online
Lecture Location: Posted on Brightspace
Lab Time: MTWR 12:35-3:35 pm
Lab Location: HP 2110
Office Hours: By appointment

Instructor

Geoff Pignotta
Office: Herzberg 2102
Phone: 613-520-2600x3024
Email: geoff.pignotta@carleton.ca

Lecture Modules:

Lecture modules will consist of numerous videos for a topic. Videos may include lecture style, field based and relevant videos from other sources. I am really trying **NOT** to have one video that consists of 3 hours of me lecturing over PowerPoint slides for each module. Therefore, some lecture modules may have numerous shorter videos while others may have fewer longer videos; this will vary from module to module. Similarly some lecture modules will be longer and some are shorter in terms of time, but note that the *cumulative* length of all lecture content for the term is actually less than what you would receive in person. Lecture modules will have associated lecture quizzes. There will be a total of 4 lecture quizzes and details regarding what will be covered on the lecture quizzes will be posted on Brightspace. There will also be 2 scheduled lecture exams (details below).

Ottawa Geology Virtual(?) Fieldtrip:

Normally there is a full day fieldtrip associated with this course examining the geology of the Ottawa region. If the fieldtrip is possible during summer 2022 it will take place on Saturday June 4 from 8 am to 4 pm. This trip may not be possible due to COVID-19 and a virtual fieldtrip will be completed in place of the actual trip. Additional details regarding the fieldtrip situation will be discussed during the first week of labs.

Exams:

Exams will consist of multiple choice, fill in the blanks and short answer questions. These are *not cumulative* exams and will be taken **IN PERSON** per the course schedule below.

Required Course Materials:

Laboratory Tools: Mineral Identification Kit, Hand Lens, Grain Size Card available at Science Stores. Please make sure you have these purchased for the first day of lab.

Camera: This can be a cellphone or other camera. Some lab exercises may require you to document via photos your activities and upload them to Brightspace as part of exercise submission.

Optional Course Materials:

Textbook: Marshak, Earth: Portrait of a Planet 6th ed. W. W. Norton & Co, 2008 ISBN: 978-0393640137
Paper and digital versions are available in the Carleton University Bookstore.

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.

Message from the Provost:

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are [a number of actions you can take](#) to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's [symptom reporting protocols](#).

Masks: On the recommendation of Ottawa Public Health, Carleton will be maintaining the mandatory [COVID-19 Mask Policy](#) until further notice. The policy requires masks to be worn in all university buildings, including offices, classrooms and labs.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in [cuScreen](#) as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the [University's COVID-19 website](#) and review the [Frequently Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.

Conflicts with Course Requirements:

Students with conflicts for **ANY** examination or quiz must have a note from an employer or a medical certificate (see below) in order to write the exam/quiz at another date. Unless caused by illness, all conflicts **MUST** be reported to the instructor **PRIOR** to the exam/quiz date. If an exam/quiz is missed due to illness contact regarding a deferral must be made within 24 hours of the exam/quiz deadline. In the case of a serious illness, see the rules concerning deferral of an exam or assignment at <https://carleton.ca/registrar/special-requests/deferral/>.

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 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 is 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/>

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) 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. This documentation and arrangements for a deferred exam must be made no more than 24 hours after the exam.

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.* 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.

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.

For this course (and all other courses at Carleton), it is extremely important to understand that you cannot copy and paste material from websites or publications into the assignment answer boxes on Brightspace. This is plagiarism, and it is easy to spot during grading of assignments. When formulating an answer to an assignment question, be sure to reword the material from websites or publications into your own words, then type that into the answer boxes. Identification of plagiarised material in an assignment answer will result in an automatic zero points for that question. Repeated instances of plagiarism will result in harsher consequences that may include zero on entire an entire assignment, reduction of course final grade, withdrawal from course, letter of reprimand from the Dean of the Faculty of Science.

I encourage students to work together on assignments. **HOWEVER**, each student must submit answers to questions in their own words, not the words used by another student that you are working with. Be sure that you and your co-worker word your submitted answers differently. If the answers submitted by one student for an assignment are identical to those submitted by another student, *both students will be assigned a grade of zero for the question.*

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>

Summer 2022 Tentative Laboratory Schedule

Lab	Date	Topic	Weight (%)	Lecture
1	05/16	Understanding Scalar Quantities in Earth Science	0	1,2
2	05/17	Physical Mineralogy	1	3,4
3	05/18	Igneous Rocks	1	5,6
4	05/19	Sedimentary Rocks	1	7
5	05/24	Metamorphic Rocks	1	8
6	05/25	Geology of Hog's Back Park	1	7
	05/26	Lab Exam	20	
7	05/21	Introduction to Topographic Maps & Aerial Imagery	5	17,18
8	05/22	Geologic Time	5	1,2
9	05/23	Introduction to Geologic Maps and Cross-sections	5	17,18
10	05/27	Introduction to Earthquakes and Seismicity	5	9,10
11	05/28	Characteristics of the Ocean Floor & Plate Tectonics	5	13-16

Course Outline (*TENTATIVE SCHEDULE ONLY*)

Topic	Textbook Readings
Module 1	
Course introduction	
Our Universe, Solar System and Earth Formation	Chapter 1
Geochronology	Chapter 12
Module 2	
Physical mineralogy	Chapter 5
The Rock Cycle	Interludes A & C
Module 3	
Igneous rocks and volcanic hazards	Chapters 6 & 9
Module 4	
Sedimentary rocks and processes	Chapter 7
Module 5	
Metamorphic rocks	Chapter 8
Lecture Exam #1 – 9:00-11:00 am on Friday May 27, 2022 in HP 2110 (Lab Room)	
Module 6	
Earthquakes and Earthquake Hazards	Chapter 10
Module 7	
Plate tectonics	Chapters 3 & 4
Earth Interior and Geophysics	Chapter 2; Interlude D
Module 8	
Deformation and Mountain Building	Chapter 11
Module 9	
The Hydrologic Cycle	Interlude F
Rivers and flooding	Chapter 17
Groundwater Systems and Resources	Chapter 19
Module 10	
Energy resources	Chapter 14
Lecture Exam #2 – 9:00-11:00 am on Friday June 10, 2022 in HP 2110 (Lab Room)	