EXPLORING PLANET EARTH
ERTH 1006
Fall 2024

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 and mathematics to tackle complex issues. As our human population approaches 7.5 billion people, and if we wish to maintain and improve the quality of life on this planet, 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 effect 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 tar sands for petroleum 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. In 2018, a massive volcanic eruption at Kilauea Volcano, Hawaii, destroyed 700 homes, all of which were built on an active volcanic rift zone. Everyone there knew about the rift zone under their homes, but simply hoped that an eruption would never occur in their neighbourhood.

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.

Land Acknowledgement

We acknowledge that the land on which we gather is the traditional and unceded territory of the Algonquin nation.

Course Pre-requisites:

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

Course Evaluation:

The course includes three major components. Instruction consists of three hours of lectures per week, in person. THIS COURSE IS NOT OFFERED AS A LECTURE-ONLY COURSE. Labs are only offered on-campus, in person. 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, held on a Saturday in early October.

In-class quizzes (Wooclap)	5%
Lecture Midterm Exam	20%
Lecture Final Exam	25%
Lab Quizzes	5%
Lab Exercises	20%
Lab Practical Exam	20%
Ottawa Geology Field Trip	5%

The **compulsory Ottawa field trip** will be held on Saturday, October 5th from 8:30AM to 4:00PM. More details will be provided during lecture periods.

Required Course Materials:

Textbook: "Physical Geology", by Plummer, Carlson, and Hammersley, 17thth Edition, McGraw-Hill. Available at the Bookstore. A used, previous edition (14-16) is fine. The e-book can be purchased through the McGraw-Hill website: https://www.mheducation.ca/highereducation/products/9781260136982/connect+online+access+for+physical+geology/

Laptop, tablet or cell phone with Internet connectivity to participate in the Wooclap class quizzes.

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)

Class Schedule:

Lecture Time: Tuesday & Thursday 4:05-5:25PM
Lecture Location: 2200 RB
Office Hours: Tuesday & Thursday 2:00-3:45PM

Lab Time: Consult your schedule
Lab Location: 2110 HP

Instructor Information:

Brian Cousens (he/him/his)
Office: Herzberg 2259
Phone: 613-520-2600 x4436
e-mail: brian.cousens@carleton.ca

Lecture Exams:

These are *not cumulative* exams and will be taken IN PERSON ONLY. The lecture midterm exam will be held OUTSIDE OF CLASS TIME, with a date/time being determined by Scheduling and Examination Services. The midterm examination date/time and location will be relayed as soon as has been scheduled. The final exam will be scheduled during the December exam period. 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.

Labs:

All aspects of the labs will be discussed during the first week of lab. While lecture content and lab content are complimentary in nature there is no overlap in the assessment. That is, you will not see material specific to labs on lecture exams and vice versa.

Teaching Statement:

I am committed to fostering an environment for learning that is inclusive for everyone regardless of gender identity, gender expression, sex, sexual orientation, race, ethnicity, ability, age, class, etc. It is my hope that our class will support diversity of experience, thought, and perspective.

Course-level 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, 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 course requirement (exam, lab, quiz, field trip) or who miss a course requirement due to illness or otherwise **MUST** report to the instructor by e-mail **PRIOR** to the due date. If this is not possible contact regarding a deferral must be made **within 24 hours** of the missed deadline. If you require accommodations for this course that are longer than the 5-day (short-term) period, please email me to discuss how/whether accommodation needs could be met for this course. The policy for deferring a Final Exam is the same as Conflicts with Course Requirements above, with the exception that you must follow the instructions on the Registrar's website for Deferred Exams which can be found here: https://carleton.ca/registrar/deferral/

Student Accommodations:

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

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: **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/

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 at least 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 labs or 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.

Academic dishonesty, in whatever form, is destructive to the values of the university, and risks harming the university's reputation as a place of learning and innovation. Furthermore, it is unfair and discouraging to those students who pursue their studies honestly. A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. A list of standard sanctions in science can be found here.

Additional details about this process can be found on the Faculty of Science Academic Integrity website. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students.

Student Concerns:

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to Ombuds services .

Community Guidelines:

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity*. In our course, we will seek to behave with these values in mind:

	As students, we will…	As a teaching team, we will…
Honesty	• Honestly demonstrate our knowledge and abilities on assignments and exams • Communicate openly without using deception, including citing appropriate sources	• Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams • Communicate openly and honestly about the expectations and standards of the course through the syllabus, and with respect to assignments and exams
Responsibility	• Complete assignments on time and in full preparation for class • Show up to class on time, and be mentally/physically present • Participate fully and contribute to team learning and activities	• Give you timely feedback on your assignments and exams • Show up to class on time, and be mentally & physically present • Create relevant assessments and class activities
Respect	• Speak openly with one another, while respecting diverse viewpoints and perspectives • Provide sufficient space for others to voice their ideas	• Respect your perspectives even while we challenge you to think more deeply and critically • Help facilitate respectful exchange of ideas
Fairness	• Contribute fully and equally to collaborative work, so that we are not freeloading off of others • Not seek unfair advantage over fellow students in the course	• Create fair assignments and exams, and grade them in a fair, and timely manner • Treat all students equitably
Trust	• Not engage in personal affairs while on class time • Be open and transparent about what we are doing in class • Not distribute course materials to others without authorization	• Be available to all students when we say we will be • Follow through on our promises • Not modify the expectations or standards without communicating with everyone in the course
Courage	• Say or do something when we see actions that undermine any of the above values • Accept a lower or failing grade or other consequences of upholding and protecting the above values	• Say or do something when we see actions that undermine any of the above values • Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

* This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Tentative Lecture Topic Schedule[#]

Lecture	Dates	Topics	Text Chapters
1	Sept. 5	Course Intro; Solar system,	1, 8
2	Sept. 10	Planetary Geology, Earth Formation, The Continents, Geochronology	1, 8
3	Sept. 12	Minerals	2
4	Sept. 17	Minerals	2
5	Sept. 19	Igneous Rocks	3,4
6	Sept. 24	Volcanoes	3,4
7	Sept. 26	Sedimentary Rocks	6
8	Oct. 1	Metamorphic Rocks	7
9	Oct. 3	Earth Interior, Seismology	16,17
10	Oct. 8	Seismology, Earthquakes	16,17
11	Oct. 10	Gravity, Isostacy	17
12	Oct. 15	Heat Flow	17
13	Oct. 17	Geomagnetism	17
	Oct. 21-25	**Study Break**	
14	Oct. 29	Plate Tectonics	17, 18, 19
15	Oct. 31	Plate Tectonics	17, 18, 19
16	Nov. 5	Rock Deformation	15
17	Nov. 7	Rock deformation, Mountain Building	15, 20
18	Nov. 12	Resources: Water, Metals	11, 22
19	Nov. 14	Energy, Alternative Energy, Climate Change	22, 21
20	Nov. 19	Geology of Canada	pdf
21	Nov. 21	Geology of Canada	pdf
22	Nov. 26	Geology of Canada	pdf
23	Nov. 28	Careers in Earth Sciences/Review	
24	Dec. 3	Review	
25	Dec. 5	Review	

Lab Topic Schedule

Week	Dates	Topics	Weight
	09/3-09/6	No Labs	
1	09/9-09/13	Understanding Scalar Quantities in Earth Science	0
2	09/16-09/20	Physical Mineralogy	1
3	09/23-09/27	Igneous Rocks	1
4	09/30-10/4	Sedimentary Rocks	1
5	10/7-10/11	Metamorphic Rocks	1
6	10/14-10/18	Geology of Hog's Back Park	1
7	10/21-10-25	Fall Break *(prepare for lab exam)*	
8	***10/28-11/1***	***Lab Exam***	20
9	11/4-11/8	Introduction to Topographic Maps and Aerial Imagery	3
10	11/11-11/15	Geologic Time	3
11	11/18-11/22	Introduction to Geologic Maps and Cross-sections	3
12	11/25-11/29	Introduction to Earthquakes and Seismicity	3
13	12/2-12/6	Characteristics of the Ocean Floor & Plate Tectonics	3