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EXPLORING PLANET EARTH
ERTH 1006
Summer 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 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 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. 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,

resulting in the destruction of a nuclear power plant and the spread of radioactive particles into the environment.

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.

The course includes two major components. Instruction consists of lectures via CUOL (T section: lectures released all at once, video in Loeb D299, or *Video-On-Demand*). In addition, all students **must** register for a weekly laboratory section (L1). **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.

TEXTS AND REQUIRED MATERIALS

- 1) “Physical Geology”, by Plummer, Carlson, and Hammersley, 16th Edition, McGraw-Hill. Available at the Bookstore. A used, previous edition (14-15) 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/>
- 2) Laboratory Manual, Exploring Planet Earth. Available as a Course Pack at the Sciences Stores (Steacie 118).
- 3) Required: Mineral Identification Kit, Hand lens, Grain Size card (Science Stores)

EVALUATION

Theory: 50% - 1 Mid-term Exam (20%), Final Exam (30%).

Labs: 50% - Mid-term Lab Exam (20%), Lab Exercises (30%)

The **mid-term theory exam** will be held **OUTSIDE OF CLASS TIME**, on Saturday May 18th from 9:00AM – 11:00AM, since students are taking this course through CUOL.

The **final exam** will be held **OUTSIDE OF CLASS TIME**, on Friday May 31st from 6:00PM – 9:00PM and will be cumulative.

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 Examinations, Field Trip, Labs or Assignments

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 field trip make-up assignment. Unless caused by illness, all conflicts **MUST** be reported to the instructor **PRIOR** to the exam date. If a lab exam is missed, contact the First-year Lab Coordinator, Geoff Pignotta, immediately. In the case of a serious illness, see <http://carleton.ca/registrar/special-requests/deferral/> for the rules concerning deferral of an exam or assignment. 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 mid-term lab exam will be communicated by the First-year Lab Coordinator.

STUDENT ACCOMMODATIONS

Requests for Academic Accommodation

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: carleton.ca/equity/wpcontent/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: carleton.ca/equity/wpcontent/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 613-520-6608 or pmc@carleton.ca for a formal evaluation or 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, meet with your instructor as soon as possible to ensure accommodation arrangements are made. carleton.ca/pmc

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: 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/wpcontent/uploads/Accommodation-for-Student-Activities-1.pdf>

For more information on academic accommodation, please contact the departmental administrator or visit: students.carleton.ca/course-outline

Plagiarism

The University's Senate defines plagiarism in the regulations on instructional offences as: "to use and pass off as one's own idea or product work of another without expressly giving credit to another". *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. Additional details regarding the Carleton University Academic Integrity policy can be found here: <http://carleton.ca/senate/wp-content/uploads/Academic-Integrity-Policy1.pdf>

Medical Certificates

Please note, that in this course, on all occasions that call for a medical certificate you must use (or furnish the information demanded in): http://carleton.ca/registrar/wpcontent/uploads/med_cert.pdf

LECTURE TOPIC SCHEDULE

Lecture	Suggested Dates	Topics	Text Chapter
1	05/06	Course Intro; Solar System	1, 8
2		Planetary Geology, Earth Formation, The Continents, Geochronology	1, 8
3	05/08	Minerals	2
4		Minerals	2
5	05/09	Igneous Rocks	3, 4
6		Volcanoes	3, 4
7	05/13	Sedimentary Rocks	6
8		Metamorphic Rocks	7
9	05/15	Earth Interior, Seismology	16, 17
10		Seismology, Earthquakes	16, 17
11	05/21	Gravity, Isostasy	17
12		Heat Flow	17
13		Geomagnetism	17
14	05/22	Plate Tectonics	17, 18, 19
15		Plate Tectonics	17, 18, 19
16	05/23	Rock Deformation	15
17		Rock Deformation	15, 20
18	05/24	Resources; Water, Metals	11, 22
19		Resources; Energy	22
20	05/27	Geology of Canada	PDF
21		Geology of Canada	PDF
22		Careers in Earth Science	
23	05/29	Review	
24		Review	

LAB SCHEDULE

Lab	Date	Topic	Weight (%)	Lecture
	05/06	No Labs		
1	05/07	Understanding Scalar Quantities in Earth Science	0	1,2
2	05/08	Physical Mineralogy	1	3,4
3	05/09	Igneous Rocks	1	5,6
4	05/13	Sedimentary Rocks	1	7
5	05/14	Geology of Hog's Back Park	1	7
6	05/15	Metamorphic Rocks	1	8
	05/16	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