

ERTH 4303: Resources of the Earth Winter 2022 Course Outline

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Lectures: Monday & Wednesday 1 to 2:30pm, **in person** in 103 Steacie

Office Hours: by appointment only (please e-mail)

Course objective:

In this course students will learn about the seemingly vast but ultimately limited resources of this planet. Not only will we cover life essentials like clean air, fresh water, food and forestry products but also all the metals, minerals and energy resources that make modern civilization possible. We will explore how and where they are found, how they are extracted, processed and consumed and how that impacts our environment. Lastly, we will assess the sustainability of our resource and energy use in light of an exponentially growing world population and the changing climate.

Textbook and Supplementary readings: no textbook required.

For those of you who want to read up on the material, I recommend:

Stephen E Kesler and Adam C Simon (2015) *Mineral Resources, Economics and the Environment*. Cambridge University Press [ISBN 1107074910].

James R. Craig, David J. Vaughn, Brian J. Skinner (2011) *Earth Resources and the Environment*, 4th edition, Prentice Hall, 508p.

Vaclav Smil, 2017, *Energy and Civilization*. Available for free download from Carleton Library.

Vaclav Smil, 2014, *Making the Modern World: Materials and Dematerialization*. One print copy in the Carleton University Library. \$33.00 on Amazon.ca

Vaclav Smil, 2012, *Harvesting the Biosphere: What We Have Taken From Nature*. One print copy in the Carleton University Library.

Vaclav Smil, 2016, *Still the Iron Age: Iron and Steel in the Modern World*. One copy available for online reading through Carleton Library. \$75 on Amazon.ca

Course notes: lecture ppts will be posted to the course website on Brightspace before the class. At the end of each lecture will be a slide with questions for you to review, which will be tested in a weekly quiz.

Assignment: research a commodity of your choice (details to be announced on Brightspace), write a report and present a short talk on it in class for 30% of your mark.

Marking:

11 on-line quizzes	33%
Commodity assignment	30%
Final exam or essay	37%

Course Schedule Winter 2022

Jan 10. (1) Introduction: Humans on Earth
Jan 12. (2) Air
Jan 17. (3) Water & the Geosphere
Jan 19. (4) Metals, Ore Deposits & Exploration
Jan 24. (5) Mining & Processing Methods
Jan 26. (6) Mining Economics
Jan 31. (7) Base Metals: Cu, Zn, Pb, Sn
Feb 2. (8) Iron, manganese and steel
Feb. 7. (9) Ferro-alloys: Cr, V, Co, Ni, Mo
Feb. 9. (10) Light Metals: Ti, Al, Si, Mg
Feb.14. (11) Tech Metals: Li, Be, Ga, Ge, Cd, In, As, Sb, Se
Feb.16. (12) Rare metals: REE, Y, Sc, Zr, Hf, Nb, Ta
Feb. 21/23 <i>reading week</i>
Feb.28. (13) Precious Metals I: Silver, Gold, Mercury
Mar. 2. (14) Precious Metals II: Platinum Group Elements, Re, W, Tl, Bi
Mar. 7. (15) Industrial minerals I: fertilizer & chemicals (N, P, K, Na, B, S)
Mar. 9. (16) Industrial minerals II: Ca, Sr, Ba, Cs, F, Cl, I, Br
Mar.14 (17) Industrial minerals III: construction materials, clay & zeolites
Mar.16. (18) Diamond & Gemstones
Mar.21. (19) (Alternative) Sources of Energy
Mar 23. (20) Uranium and nuclear energy
Mar 28. (21) Fossil Fuels
Mar 30. (22) The Biosphere; Forestry products, tree fruit, bio fuels
April 4. (23) Food from Agriculture (cereals, pulses, tubers, fruit & vegetables)
April 6. (24) Animal products (Beef, Pork, Lamb, Dairy, Fish, Seafood)
April11. (25) Threats to Resources, Synthesis, Outlook and Discussion

On-line delivery of lectures and labs from Jan 10th to Jan 28th, 2022 (or until further notice)

During this period lectures will be taught synchronously on-line only. Please make sure you have a strong and stable internet or WiFi connection (use a WiFi booster if needed or plug an ethernet cable directly into the internet modem). Links to on-line sessions will be posted on the EARTH4303 course website on Brightspace (CuLearn).

Missed tests or late assignments:

If you miss a lecture, we expect you to catch up on the material on your own by reading the lecture ppt (lectures will not be recorded). Assignments are due when the commodity appears in the course schedule and cannot be deferred. Failure to present on the due date will lead to deductions from your mark. The TA needs to have all the work in a timely manner so he can focus on marking one item at a time.

Learning Outcomes:

By the end of the course, each attentive student will acquire the knowledge in the lecture allowing them to understand and critically evaluate historical, contemporary, and projected:

- sources and material flows of the key mineral and energy resources used in contemporary society
- economic and environmental constraints on mineral resource utilization
- global supplies of food from agriculture and from natural sources
- threats to climate, air, food and fresh water supplies

In the context of Earth Science Learning Outcomes, this course will contribute to the following:

1. Explain the origin, consumption and impacts of humans on natural resources (e.g., energy, mineral, water, atmosphere) – Outcome Mastered
2. Critically evaluate geoscience data and their uncertainty to produce a scientific report – Outcome Reinforced
3. Produce independent research – Outcome Mastered
4. Demonstrate initiative, problem solving skills, and appreciation of knowledge limitations – Outcome Mastered

Covid-19 Requirements

Carleton University requires **mandatory vaccination** against COVID-19 for all students, teaching assistants and instructors participating in any in-person university activities. Since both lectures and labs in this course are **in-person**, only fully vaccinated students may participate in EARTH 4303. For more information, visit:

<https://carleton.ca/covid19/health-and-safety/covid-19-vaccines/>

cuScreen: everyone entering Carleton University campus must upload their **vaccine documents** to **cuScreen** prior to the start of the course and self-declare their **health status** before they come to class **every day**. Wear a mask and wash hands upon entering the building, and scan QR Codes in your path as you progress towards your lecture room. For details, please review the Return To Campus COVID-19 Teaching Labs and General Policies forms.

For the most recent information on COVID-19 protocols, visit:

<https://carleton.ca/covid19/policies-and-protocols/>

General Safety Measures

All members of the Carleton community are required to follow general COVID-19 prevention measures and all mandatory Ontario Public Health requirements, since the course is in-person. This includes wearing a well-fitted mask that covers the nose, mouth and chin at all times; physical distancing; bring your own hand sanitizer; practise proper hand hygiene, respiratory and cough etiquette; mandatory self-screening prior to coming to campus daily; and using the QR codes when entering/exiting the class. When in class or in a lab, students **must** maintain a minimum of 2-metre distance apart. A hand must be raised to signify the need for help.

Students, TA's or instructors should not come to campus if they feel unwell.

In the case of classes or meetings being held on-campus in our lecture rooms or teaching labs, you must follow the COVID-19 screening protocols established by the University: <https://carleton.ca/covid19/policies-and-protocols/> .

Course Copyright

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copyright protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, course outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are **not permitted to reproduce or distribute** lecture notes and **course materials publicly for commercial or non-commercial purposes** without express written consent from the copyright holder(s).

Academic Integrity

The University Academic Integrity Policy defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This 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, material on the internet and/or conversations.

Examples of plagiarism include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another’s data or research findings without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one’s own; and
- failing to acknowledge sources through the use of proper citations when using another’s work and/or failing to use quotations marks.

Plagiarism is a serious offence that cannot be resolved directly by the course’s instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of “F” for the course or even suspension or expulsion from the University.

Academic Accommodations

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](mailto:equity@carleton.ca) at equity@carleton.ca.

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 Obligations

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, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#)

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, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#)

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. For more details, visit the [Paul Menton Centre website](#).

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 where 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 the [Equity and Inclusive Communities website](#).

Accommodations 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. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF, 25KB\)](#).