

Syllabus GEO-007 Minerals and Human Health

Professor – Larissa Dobrzhinetskaya larissa@ucr.edu

TA - TBA

Spring 2023

Description:

The course is an undergraduate-level (**4 units**); it has dual learning goals:

(i) to gain knowledge of the physical and chemical processes dealing with systems where rocks and minerals interact with the hydrosphere, atmosphere, biosphere and human activity associated with exploitation and utilization of Earth's resource;

(2) to develop understanding in data collection from environmentally damaged areas, evaluation of adverse effects of hazardous Earth's materials and their concentrations in air, water, and food for the safe consumption and public health.

Course duration – 10 Weeks

COURSE FORMAT:

This is an asynchronous course that can be done on your own time.

However, there are deadlines for completion of each assignment which includes modules and quizzes, discussions and team projects.

MODULES. We will cover each week the different topics presented as MODULES (the equivalent of lectures). The MODULES contain the most important information which is accompanied by a written text and a human voice. Each module contains **10 to 20 quizzes** and successful/non-successful answers to quizzes are confirmed with the Canvas automatic grading. The Canvas system will provide evidence and evaluation of how students understood the subject.

DISCUSSION SESSIONS. At the end of each MODULE, students will participate in discussion sessions. The discussion sessions are prepared by a team of students according to the schedule. Each team will include 5 students. The discussion leading teams will post questions or/and propose some interesting materials collected from online or scientific publications, and will facilitate the discussion.

VIRTUAL LABORATORY:

students will participate in the Virtual Laboratory during Week 4

STUDENT TEAM PROJECTS.

Each team will choose a **new topic related to minerals' impact on human health and the environment** to prepare their Team Project. Each team project will be evaluated by all the other students, with TA and Instructor performing the final averaging of grades. **Each Team Project will be delivered as the PowerPoint presentation.** Projects considered the most interesting will become online poster projects, serving as excellent examples available for future GEO-007 course sessions. Student evaluators will receive a rubric to grade Team presentations. The Team Project is intended to develop higher-level thinking skills including (i) choice of the theme and analysis of data; (ii) synthesis of ideas; (iii) evaluation of results; (iv) critiques of peer work; (v) formulation of conclusions and recommendations and (vi) working as a group.

TEXT BOOK: Dobrzhinetskaya L., 2015. Minerals & Human Health, Cognella Ltd.

The book can be purchased **at UCR bookstore and online from** the Publisher store: <https://store.cognella.com/81015-1A-009>

We are always with you during Zoom - Office Hours.

INTRODUCTION

MODULE 1. Basic principles of geology. Composition and structure of the Earth.

Quizzes related to the Module' subject. Text Book: *Minerals and Human Health*, Dobrzhinetskaya L., 2015, Cognella Ltd.: **pp. 3 -51.**

DISCUSSION 1:

(i) Is the collision of tectonic plates a “quiet” process? What kind of processes are behind the collision?

(ii) Before the theory of plate tectonics, what did people think about the geologic processes of the Earth? In other words, why the theory plate tectonics was initially controversial?

MODULE 2. Minerals in human life, industry, politics, and science. The agricultural sector and soil sciences. Fossil fuel, energy, and water resources. Environmental sciences. Industrial minerals, materials science, and engineering (graphite, diamond, and other carbon allotropes). On the crossing roads: economy, politics and mineral resources. Conflict minerals. Minerals: biotechnologies and medicine.

Quizzes related to the Module' subject. Text Book: *Minerals and Human Health*, Dobrzhinetskaya L., 2015, Cognella Ltd.: **pp. 60-67.**

DISCUSSION 2.

(i) Conflict minerals, mineral resources, political powers and economic growths in developing countries.

(ii) "Blood Diamonds: The International Response"

(iii) Kimberly Process Certificate created to stop "Blood Diamonds".

(iv) What kind of other minerals, besides diamond, are also in the group of "conflict minerals"?

(v) What is the difference between a rock and a mineral?

MODULE 3. Medical Geology. On crossing over disciplinary boundaries. Historical connections and how did our ancestors use minerals for healing diseases? Traditional medicine and geosciences. Most dangerous toxic elements and hazardous geological materials. Hazardous minerals.

Quizzes related to the Module' subject. Text Book: *Minerals and Human Health*, Dobrzhinetskaya L., 2015. Cognella Ltd.: **pp. 67-96**

DISCUSSION 3:

(i) Prehistoric roots of medical geology. Good and bad sides of traditional medicines.

(ii) Do you think that the medical geology discipline has a future? Will be it modified, and if so, how and in what kind of direction?

MODULE 4. Volcanic hazards: primary and secondary adverse effects on human health. Earthquakes hazards: destructions of the environment and outbreaks of Valley Fever epidemic disease in California. Quizzes related to the Module' subject. Text Book: *Minerals and Human Health*, Dobrzhinetskaya L., 2015, Cognella Ltd.: **pp.117-145.**

DISCUSSION 4:

(i) Using as an example the story of the city of Yakima, Washington which is close to Mount St. Helen, please discuss what societal and economic damages can be caused by volcanic activities.

(ii) California is a country of earthquakes. What does cause Valley Fever disease?

MODULE 5. Dust and its adverse effect on human health. Atmosphere composition; dust and air pollution. Minerals' contribution to air pollution. A lifetime of dust particles. Particulates matter: primary and secondary, their diversity and interactions. Natural and industrial dust and its adverse effects on human health: silicosis. Domestic (house) dust. Quizzes related to the Module' subject. Text Book: *Minerals and Human Health*, Dobrzhinetskaya L., 2015, Cognella Ltd.: **pp.97-105**

DISCUSSION 5:

- (i) Discuss Domestic and intercontinental dust storms.
- (ii) Why is dust dangerous?
- (iii) Particulate matter and their hazardous effect on human health.
- (iv) Discuss particulate matter classification and indoor and outdoor air quality.

MODULE 6. Geological sources of mineral dust. Hot deserts and their geographic distributions. Intercontinental dust storms. Loess deposits. Rock-forming minerals of loess, their geographical distributions. The hazardous effect of mineral dust. Mineral dust and pneumoconiosis/silicosis in High Asian regions. Case of studies: September 11, 2001- Manhattan dust, New York. Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: **pp.105-116.**

DISCUSSION 6:

(i) The health impact of dust storms is principally determined by the particle size; (ii) Heavy sandstorms are a major pollution source in China; (iii) How Trans-Pacific air pollution from sandstorms in China affected human health in California. (iv) Manhattan dust - Why was 9/11 dust toxic? (v) 18 years later: how has 9/11 toxic dust affected New Yorkers' health?

VIRTUAL LABORATORY:

PART 1 will show you step by step how rocks and minerals are collected in the field and are later brought to laboratories to determine if they are potentially hazardous. The approaches and methods used in field researches vary across disciplines. See the description posted on the Canvas platform.

PART 2 virtual demonstration of how optical microscopy helps to recognize minerals in the samples collected from the field. See the description posted on the Canvas platform.

PART 3 - the studies of minerals and rocks micro- and nanoparticles to recognize minerals atomic structure, surface characteristics of the micro-nano particles, their shape, and chemical composition. See the description posted on the Canvas platform.

PART 4 - students' team project. Students will prepare their own Team Project as a PowerPoint Presentation. See the description posted on the Canvas platform.

MODULE 7. Geochemical classification of elements. Essential and non-essential elements.

Human geophagy - eating "earth": adverse health effects and concepts.

Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: **p.147-153.**

DISCUSSION 7:

(i) What is the difference between elements, minerals, and rocks?

(ii) Geophagy: why do people eat soil?

(iii) From the video discussing toxic geophagy, what are some key factors that make the soil, and tailings from the described areas particularly dangerous/toxic?

MODULE 8. Mercury minerals and their toxicity. Geological occurrences and mining conditions. Mercury and gold mining. Mercury path to the environment. Minamata disease in Japan: an epidemic of mercury poisoning caused by industrial pollutions. Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: **pp.181-206**

DISCUSSION 8:

(i) How can people be exposed to mercury?

(ii) Saving the Bay - The aftermath of the Gold Rush: Mining and mercury in San Francisco Bay

(iii) Toxic mercury poisons miners by the millions

(iv) Liquid mercury found under the pyramid in Mexico

Midterm Proctored exam

MODULE 9. Arsenic. Arsenic – a toxic metalloid. Arsenic in minerals, rocks, and environment; arsenic adverse effect on human health. Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: p.154-160.

DISCUSSION 9:

(i) Most interesting facts about arsenic from ancient times to the present.

(ii) Discuss the arsenic contamination in a mine, and how does freezing arsenic-rich dust-tails make arsenic to be no longer toxic?

(iii) We encourage each student to find any other interesting facts about arsenic.

We want to see what kind of interesting information you come up with. Make sure you cite your sources.

MODULE 10. Arsenic in drinking water. Case study: Arsenic-related epidemic diseases in Bangladesh and other countries. The contamination of groundwater by arsenic in Bangladesh is the largest poisoning of a population in the history of humankind. Quizzes related to the Module' subject.

DISCUSSION 10:

- i) What are problems with the wells in Bangladesh and why is it important to monitor these wells?
- (ii) What are potential sources of arsenic contamination in groundwater, and how might this occur?
- (iii) What did we learn from the Bangladesh case?

MODULE 11. Case studies:

- (i) **“Arsenic contaminations in California.”** -Dr. Charles Alper - United States Geological Survey.
- (ii) The Module presents two separate case studies conducted by Dartmouth Medical School.
 - (a) High arsenic concentrations in New Hampshire and Main drinking water.
 - (b) Arsenic as a chemical byproduct in the gold mines: Giant Mine in Yellowknife, Canada.

Quizzes related to the Module' subject (10 quizzes).

DISCUSSION 11:

- (i) Arsenic in California: who is at risk?
- (ii) New Hampshire and main cases: Should well owners wait for regulations? Would it be better for them to periodically test their private well for Arsenic?
- (iii) It is important to educate the local population and provide Arsenic kits to test the water. How long does it take to get the result of water tested for Arsenic?
- (iv) Canada's case: What are some physical effects of being exposed to large doses of arsenic? What does exposure eventually lead to?
- (v) How would arsenic in groundwater affect local people living near the mine? List multiple effects.
- (vi) What new facts have you learned from this YouTube? Think about what has surprised you...

MODULE 12. Cadmium (Cd). Natural occurrences. Cadmium-bearing minerals. Cadmium pathway to humans and the environment. Cadmium toxicity and its adverse effect on human health. The Itai-Itai epidemic disease caused by cadmium contamination of the environment. Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: pp. 207-218.

DISCUSSION 12:

- (i) What are the most common pathways to cadmium exposure in humans?
- (ii) What health effects are associated with Cd exposure?
- (iii) What type of food can lead to a higher risk of cadmium exposure?

MODULE 13. Lead. Minerals of the lead group. World production of the lead and its use. Industrial lead smelting and refining. Lead adverse effects on human health. Lead pathway to humans and the environment: industrial contaminations; lead enriched gasoline – past & present; lead in cosmetics, paint and kid's toys. Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: pp. 219-231.

DISCUSSION 13:

Lead poisoning of water in Flint, Michigan.

- (i) The science of Flint's water crisis.
- (ii) What did “pre-flushing” do to sampling? What is the importance of checking the corrosion of pipes that are used for water?
- (iii) How were the people of Flint's health put in danger, other than lead exposure?

MODULE 14. Asbestos. Hazardous minerals of the serpentine and amphibole groups. Asbestos in our homes and their industrial applications. Quizzes related to the Module' subject (15 quizzes). Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: pp. 233-266.

DISCUSSION 14:

Asbestos Ban in the US –follow up. 2019. Asbestos Hazards and Workplace Safety

- (i) What was the asbestos being used for in the buildings?
- (ii) Why was the worker protected from being fired for whistleblowing?
- (iii) Should you test your recently bought house for asbestos?
- (iv) Under the April 2019 Final Rule, how much time do persons subject to using asbestos have to notify the EPA before any manufacturing, importing, or processing?
- (v) What are some products under the rule that are prohibited from returning to the market?

MODULE 15. Coal – a fossil geological fuel. Coal formation on the Earth. Composition and rank of the coal. World coal production and use. Toxic elements in the coal and their adverse effect on human health and the

environment. Quizzes related to the Module' subject. Text Book: Minerals and Human Health, Dobrzhinetskaya L., 2015, Cognella Ltd.: pp. 267-301;

DISCUSSION 15:

(i) Researchers have been developing a way to prevent coal ash from spilling into areas that affect the population's drinking water, etc. By introducing bacteria to coal ash, scientists have discovered a way to "bio-cement" the ash with the bacteria, effectively making the coal ash closer to solid than liquid. This has the potential to make headway in reducing toxic waste from spilling out of coal ash ponds.

(ii) The coal ash spill into the Dan River in North Carolina.

(iii) What are the impacts of coal ash leaking into the environments, especially when exposed to water?

(iv) What are arguments made about arsenic in seeps? Do you agree?

FINAL EXAM (cumulative). Proctored exam, via Zoom - online.

Grades

Grading Breakdown

Participation (20%) Student's participation includes:

- completely reading the syllabus and understanding course requirements;
- staying informed and up-to-date on all course-related work each and every week;
- participating in weekly discussion sections and completing all coursework by the assigned deadlines;
- be active on the Canvas course site by reading announcements, particularly in regard to posting and answering questions about the course and assignments.
- A majority of your participation grade will be based on your contributions to the discussion boards and answering discussion session questions. An active Leading Team will make the course a more effective and rewarding learning experience for everyone, and the Instructor and TA will take note of regular contributors.
- Note that students are NOT permitted to post any answers to the quizzes or homework assignments on Canvas or on any social media. Any instances of academic dishonesty will result in a zero for associated graded work.

Quizzes (15%)

- **Quizzes** included in Modules and Virtual Laboratory; taking these types of quizzes, students are better prepared to discuss the assigned reading and receive an opportunity to improve their performance prior to receiving a final grade.

Students Team Project (15%)

Students will prepare their report in the form of PowerPoint Presentation and submit to Canvas on the due date and time; no credit will be given for late projects.

PowerPoint Presentations will be evaluated first by students, and their final grading will be performed by TAs and Instructors.

Exams

Midterm Exam (25%)

The midterm exams will be given after the first five weeks of the quarter. Exam questions are multiple-choice and are drawn from readings of your **Text book, modules and discussions, and assignments.**

Final Exam (25%)

The final exam is cumulative and mandatory; exam questions are multiple-choice; the exam will be given during the time period scheduled by the UCR Registrar.

The GEO 007-Minerals & Human Health Midterm and Final exams will be activated in the proctoring Zoom session system.

Grades:

The Canvas electronic platform will grade your Quizzes, your participation in discussions sessions and other activities. These grades are different than those accepted by the UCR system. **At the end of the course your grades from Canvas will be recalculated to the final grades accepted by UCR.**

The final UCR grades will be based on the percentage of the total points available in the class. **The UCR letter grades will be based on the following scale:**

97% - 100% A+

88% - 97% A

85% - 88% A-

83%	-	85%	B+
77%	-	83%	B
75%	-	77%	B-
73%	-	75%	C+
67%	-	73%	C
65%	-	67%	C-
63%	-	65%	D+
57%	-	63%	D
55%	-	57%	D-
0%	-	55%	F

Academic Integrity

Here at UC, we are committed to upholding and promoting the values of the Tartan Soul: Integrity, Accountability, Excellence, and Respect. As a student in this class, it is your responsibility to act in accordance with these values by completing all assignments in the manner described and by informing the instructor of suspected acts of academic misconduct by your peers. By so doing, you will not only affirm your own integrity, but also the integrity of the intellectual work of this University, and the degree which it represents.

Should you choose to commit academic misconduct in this class, you will be held accountable according to the policies set forth by the University and will incur appropriate consequences both in this class and from Student Conduct and Academic Integrity Programs. For more information regarding University policy and its enforcement, please visit: conduct.ucr.edu.

Note that students are NOT permitted to post any answers to the quizzes or homework assignments on Canvas or on any social media. Any instances of academic dishonesty will result in a zero for associated graded work.

Downloading Digital Media Content and Recordings

Please read the following statement regarding downloading Digital Media Content and Recordings from this course. After reading the statement acknowledge that you have read it by selecting the response below.

Students MAY NOT download and/or distribute any digital media content or records of the professor's lectures without permission. Permission to download digital media content or record a class applies exclusively to the student who received permission from the professor.

The downloaded digital media content or recording may not be accessed or utilized by any other individual. No replication of the downloaded digital media content or recording may be made without the express permission of the professor.

Downloaded digital media content or recordings must not be posted to any form of digital media. Students who violate this policy are subject to disciplinary action under the UCR Standards of Conduct,

<http://conduct.ucr.edu/policies/standards.html> (Links to an external site.)

Technology Requirements

Computer Specifications for Canvas (Links to an external site.)

System requirements for Zoom web-conferencing (Links to an external site.)

Technical Support

Questions about lab's access, student accounts, Canvas, and any technical problems should be addressed to the UCR Campus Help Desk

Email: BearHelp@ucr.edu

Phone: 951-827-4848

Web: <https://its.ucr.edu/bearhelp>