

## EPSc 140 Freshman Seminar: Geology and Human Health

3 units

**Instructor:** Prof. Jeff Catalano, Rudolph Hall 242, 935-6015, [catalano@wustl.edu](mailto:catalano@wustl.edu)

**Meeting Times and Place:** MW 1 to 2:30 pm, Rudolph Hall 204

**Course Website:** <http://epsc140.wustl.edu/>

**Office Hours:** F 1:30-2:30 pm or by appointment.

### Course Objectives:

- To understand the connection between geological processes and human health, and how these are altered by anthropogenic activities.
- To comprehend the physical, chemical, and biological processes associated with natural health risks.
- To become familiar with a scientific approach for evaluating risks to human health posed by geological processes.

**Course Description:** This course explores the connections between human health and geological processes. Key concepts in geology are introduced as well as the pathways through which natural systems affect human health. A series of case studies will be presented, each describing a specific health hazard and its geological origin. The first set of studies will focus on human health effects associated with windborne exposure to harmful materials, including asbestos, dust and aerosols, and the products of coal combustion. The course will then use the topic of mercury, which is emitted into to atmosphere and then accumulates in aquatic systems, to transition to water and soil borne pathways of exposure. This will be followed by case studies exploring water availability and quality, arsenic in groundwater, with a special emphasis on widespread arsenic poisoning in South and Southeast Asia, lead in mining areas and urban soils, and radon and radioactive materials. Students will conduct team risk assessment projects as well as an individual project.

**Reading Assignments:** This course covers a novel topic for the field of Earth Science and there are currently no textbooks that cover all relevant material. Reading materials will be taken from a collection of textbooks, edited books, review articles from scientific journals, popular scientific articles from magazine such as *Scientific American* and *ELEMENTS*, and newspaper articles. The specific readings will be assigned in class, with reading materials either provided to students via handouts or posted to the course website.

During the semester, students may find it useful to refer to the following books as supplemental sources of information. These are on reserve in the Earth and Planetary Sciences library.

- *Environmental Geology*, by Montgomery, McGraw Hill.
- *Environmental Science: Earth as a Living Planet*, by Botkin and Keller, Wiley.
- *Essentials of Medical Geology, Revised*, by Selinus and others, 2013, Springer.

- *Geology and Health: Closing the Gap*, by Skinner and Berger, 2003, Oxford University Press.
- *Medical Mineralogy and Geochemistry*, by Sahai and Schoonen, 2006, Geochemical Society and Mineralogical Society of America.

**Course Responsibilities:**

<i>Participation in Class Discussions:</i>	10%
<i>Group Projects on Risk Assessments:</i>	30%
<i>Two Exams:</i>	40% (20% each)
<i>Final Paper and Presentation:</i>	20%

***Class Discussions:*** Each case study will wrap up with a discussion of outstanding issues, such as uncertainties in health impacts of specific processes, the relative role of anthropogenic and natural processes in creating an impact on human health, and potential actions that could reduce negative human health consequences. Students will be assessed on their participation in these discussions as well as their involvement in asking questions after presentations by their classmates associated with the risk assessment and final project assignments.

***Group Projects on Risk Assessments:*** Twice in the semester groups of 3 to 4 students will work on a project to assess the risk to human health associated with a specific environmental problem. Topics will be selected by the instructor based on recent events and the availability of relevant material. Potential topics include: Impacts on water quality associated with fracking, accumulation of mercury in the aquatic food chain, the Westlake landfill fire, coal ash disposal near rivers, the Fukushima disaster, the California drought, impacts of mining for rare earth elements, or the mine waste spill into the Animas River by the EPA. The goal of this activity is to have students critically assess available information, draw conclusions about potential risks, and to discuss and consider other perspectives. Early in the semester, small homework activities will be assigned to get student familiar with evaluating risks associated with natural processes.

***Exams:*** A midterm and final exam will be given to assess students' mastery of key course concepts. Topics will address both geological processes and human health impacts.

***Final Paper and Presentation:*** Students will each choose an individual topic to further investigate and will then prepare a 5-8 page (double spaced) review paper and give a short (6-8 minute) presentation summarizing their topic. Topics will be selected in consultation with the instructor and may either cover a specific aspect of a major course topic in greater detail or focus on a different topic as proposed by the student.

**Late Work Policy:** Many of the activities assigned in this course involve in-class components. Because these occur on fixed dates, such coursework cannot be completed late unless prior arrangements are made with the instructor and involve a valid excuse. Coursework that does not involve an in-class component will be accepted late but with a -10% penalty per day. Accommodations will always be provided in the case of serious medical or personal issues.

**Exam Policy:** If you miss an exam and provide the instructor with an acceptable written excuse, he may choose to schedule a make-up exam (format to be determined by the instructor) or assign 40% of your grade to the other exam. There is no guarantee that the instructor will accept your reason for missing the exam, and receiving a score of zero is a possible outcome. Accommodations will always be provided in the case of serious medical or personal issues.

**Academic Integrity:** All students are expected to adhere to high standards of academic integrity as outlined in the Academic Integrity Policy:

<http://wustl.edu/policies/undergraduate-academic-integrity.html>

If you have any doubts or questions about the policies, please ask the instructor.

**Inclusive Learning Environment:** The instructor strives to create a learning environment that is inclusive, where students of all backgrounds and identities are engaged, included, and challenged. Treatment of students and evaluations of academic performance will be assessed professionally and not based on personality, race, religion, politics, sex, sexual orientation, or personal beliefs. The instructor expects all students to be respectful and supportive of their classmates and other course participants during all course activities, especially discussions.

**Course Schedule:** The planned list of topics to be covered is described below. Specific reading assignments will be given out in class.

<b>Class Period</b>	<b>Topic</b>
M 8/24	Overview of Human Health Issues Affected by Geological Processes
W 8/26	Introduction to Geology
M 8/31	Distribution and Abundance of Elements; Exposure Pathways; Uptake of Elements
W 9/2	Introduction to Epidemiology and Toxicology ( <i>Guest lecture by Prof. Zorimar Rivera-Núñez, Program of Public Health, Brown School of Social Work</i> )
M 9/7	<b>NO CLASS – LABOR DAY HOLIDAY</b>
W 9/9	Case Study 1: Asbestos; Geological Origin of Asbestos
M 9/14	Health Impacts of Asbestos Exposure
W 9/16	<b>NO CLASS – PROF. CATALANO AT PACIFIC NORTHWEST NATIONAL LABORATORY</b>
M 9/21	Case Study 2: Dust and Aerosols; Geological Origins of Mineral Dust
W 9/23	Silicosis; Exposure to Wind-Borne Soil Pathogens
M 9/28	<i>Team Presentations of Risk Assessment Project 1</i>
W 9/30	Case Study 3: Coal; Geological Origin of Coal
M 10/5	Health Effects Associated with Coal Mining; Health Effects to Communities Downwind of Coal Power Plants; Coal Fly Ash
W 10/7	Case Study 4: Mercury; Geological Occurrences of Mercury

M 10/12	<b><i>Midterm Exam</i></b>
W 10/14	Anthropogenic Mercury Emissions; Global Mercury Cycle
M 10/19	Health Effects of Mercury Exposure
W 10/21	Case Study 5: Water Availability; Geological Control on Freshwater Availability
M 10/26	Management of Water Resources
W 10/28	Case Study 6: Arsenic; Geological Origin of Arsenic in Groundwater
M 11/2	<b>NO CLASS – PROF. CATALANO AT GEOLOGICAL SOCIETY OF AMERICA ANNUAL MEETING</b>
W 11/4	Health Effects of Arsenic Exposure ( <i>Guest lecture by Prof. Zorimar Rivera-Núñez, Program of Public Health, Brown School of Social Work</i> )
M 11/9	<b><i>Team Presentations of Risk Assessment Project 2</i></b>
W 11/11	Case Study 7: Lead; Geological and Anthropogenic Sources of Lead
M 11/16	Health Effects of Lead Exposure; Lead in Urban Soils
W 11/18	Case Study 8: Radon and Radionuclides; Geological Sources of Radioactive Materials; Anthropogenic Effect on the Creation and Dispersal of Radioactive Materials
M 11/23	Health Effects of Exposure to Radiation
W 11/25	<b>NO CLASS – THANKSGIVING</b>
M 11/30	<b><i>Final Presentations</i></b>
W 12/2	<b><i>Final Presentations</i></b>
W 12/16	<b><i>Final Exam during Scheduled Period (1 to 3 pm, Rudolph Hall 204)</i></b>

**The instructor reserves the right to modify this syllabus during the semester. These changes will be announced in class, and it is the students' responsibility to attend class or make other necessary arrangements to keep abreast of the situation.**