

Environmental Hazards

Fall 2019

Tuesdays/Fridays, 09:45 AM to 11:00 PM – HN 1022

Undergraduate PGEOG 36300

Graduate PGEOG 70554

Instructor: Enrique Lanz Oca
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Office Hours: Tuesdays, 11:15 – 12:15 am
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Course Description: On November 1st, 1755, Lisbon was devastated by one of the deadliest earthquakes in centuries. Twenty-meter high tsunamis swept the city, annihilating at least 60,000 people. From Greenland to the British Isles, to Scandinavia, Morocco, Spain, and the Caribbean islands, millions of people witnessed this unprecedented telluric event. Such was its impact that Europeans began to see Nature as an unstable and hazardous agency, driving the foundations of seismology. Through similar cases such as the Tambora volcanic eruption in Indonesia and the Chernobyl nuclear accident in the former Soviet Union, this course will introduce you to some of the main geophysical/technological phenomena that create these environmental hazards. You will acquire a solid knowledge of the tectonic system, earthquakes, volcanoes, landslides, floods, severe weather events such as hurricanes and tornadoes, droughts, coastal processes such as erosion, cliff recession as well as technological catastrophes such as dam failures, oil spills, and nuclear power station accidents. Finally, you will become aware of how humans have become one of the main forces of Nature, a process that is causing a planetary ecological crisis with extraordinary consequences such as the increase of the global temperature, the flood of extensive coastal areas, the intensification of meteorological phenomena, changes of the ecosystems, and the massive displacement and extinction of millions of living organisms. You will hone your critical-thinking skills as you learn to connect natural and manmade disasters to their cultural, technological, socio-economic, political, and gendered values. Ecological disasters, as you will see, do not equally impact every population or socio-economic group. Minorities, indigenous groups, and the poor are often exposed to the highest risks.

Course Objectives:

1. This course is designed to introduce you to the local, regional, national, and global implications of geophysical processes and anthropogenic activities that cause or have the potential to generate hazardous conditions in the ecosystems.
2. You will study how local, regional, national, and international organizations have responded to hazardous situations and thereby learn about mechanisms of predicting, monitoring, preventing, and remediating potential environmental or technological risks.
3. You will be guided in forming an independent study on environmental/technological hazards at the local, regional, national, or international levels to enhance your perception of the important role of our collective responsibility towards a sustainable future.

Expected Learning Outcomes:

A. Course-Specific Learning Outcomes:

1. Think critically about the complexities of the planet Earth, especially the intersections between physical and human phenomena.
2. Analyze the planet as a complex structure and be able to comprehend the ways in which your immediate environments are connected to both local and distant ecologies.
3. Examine preconceived notions about boundaries of all sorts, including social, political, and geographical ones. Consider the social construction of divisions between humans and non-humans.

You will be assessed through your participation in class discussion, essays, and Blackboard responses.

B. General Education Learning Outcomes:

1. Communication Skills: You will be able to write, read, listen and speak critically and effectively. Your ability to speak and listen effectively will be assessed through your participation in class discussions. Your ability to read critically will be assessed by your comments on course readings. Writing skills will be assessed through essays as well as regular responses on Blackboard covering lectures, readings, and class discussions.
2. Scientific Reasoning and Social and Behavioral Sciences: You will be able to apply the concepts and methods of the natural and social sciences. Your ability to apply concepts and methods of sciences will be measured via class discussions, essays, and responses on Blackboard.
3. Information and Technological Literacy: You will be able to collect, evaluate and interpret information and effectively use information technologies.
4. Values: You will be able to make informed decisions based on an understanding of personal values, human diversity, multicultural awareness and social responsibility.

Readings:

There will be no textbook. The course will include assigned materials that are available through articles, texts, chapters, films, and audios. These materials are available in the section “Course Materials” on Blackboard. Where indicated on the syllabus, materials will be found online.

Assignments:

Depending on your status as undergraduate or graduate, you will be expected to complete the following assignments:

Undergraduate Students

1. Final research paper
 - a. 10 pages
 - b. at least 5 references
2. Research paper proposal (2 pages)
3. Oral presentation of your research paper (5 minutes)
4. Mid-Term exam: Required
5. Final exam: Required

Graduate Students

1. Final research paper
 - a. between 15 and 20 pages
 - b. at least 10 references
2. Research paper proposal (3 pages)
3. Abstract of the research paper:
Extra-credit (250 words plus keywords)
4. Oral presentation of your research paper (5-10 minutes)
5. Mid-Term exam: Required
6. Final exam: Required
7. Meetings outside the class

(required at least once)

Evaluation:

1. Undergraduate student grades will be based upon the following:

	Percentage of Final Grade
Research paper proposal	15%
Final Research Paper	35%
Oral Presentation of your research paper	5%
Mid-term exam	20%
Final exam	20%
Participation in discussion of assigned materials	5%

2. Graduate student grades will be based upon the following:

	Percentage of Final Grade
Research paper proposal	15%
Final Research Paper	40%
Oral Presentation of your research paper	10%
Mid-term exam	15%
Final exam	15%
Participation in discussion of assigned readings	5%
Abstract of the research paper	(extra-credit 5%)

Final letter grades will be assigned based on the CUNY grading policy that can be found in the online undergraduate catalog available at: <http://catalog.hunter.cuny.edu/>.

These assignments are described in detail in “Assignments Description” located in “Course Materials” on Blackboard.

Course Policies:

Attendance:

I will take attendance at every class meeting. You should arrive in class on time and stay for the entire session. If you will miss class for any reason, you should discuss this with me ahead of time. You are responsible for any material you may miss. You are allowed five hours of absence, not five days. A low attendance could determine the distinction between an “F” or “WU” grade. Finally, the tardiness generates constant interruptions of the class. The continuous tardiness could generate a reduction of points for the final grade. **DO NOT BE LATE TO CLASS.**

Incompletes:

I do not give incompletes (IN) except under the most extraordinary and documented medical emergencies. No late assignments will be accepted. Without a valid medical excuse, you will receive a grade of zero (0) on any assignment missed. If, for a valid medical emergency, you do miss an assignment, you must contact me within 48 hours of the missed assignment and present acceptable documentary evidence for your absence. At the time of the request, you must also complete a Contract to Resolve an Incomplete Grade in consultation with me. We will agree on what needs to be completed and when it will be due and, if you meet the mutually agreed upon conditions, your course grade will be recomputed and a new grade, if appropriate, will be submitted. I will allow only one semester in which you can resolve the IN/FIN. After that time

no request will be considered. The contract form is available in the Department of Geography office, HN 1006, during normal business hours or in OneStop on the 2nd floor of the North Building.

To receive a CR/NC you must have completed all course requirements and have requested the CR/NC option no later than the last scheduled lecture. That means all written assignments, quizzes, exams (including the final exam) must have been completed. If you choose this option, then all grades above 70% will be assigned CR and 69.9% and below will be assigned NC unless you choose the assign D option for grades between 60 and 69.9. Finally, CR/CN is only available to undergraduate students. More information is available at

<http://www.hunter.cuny.edu/advising/how-to/file-credit-no-credit-cr-nc>

Classroom Electronics Use:

I permit the use of laptops and tablets **ONLY** for the purpose of taking notes during lecture and discussion. All other personal electronics should be turned off or set to silent before entering the classroom. Absolutely no texting is allowed during class. Any use of electronics beyond their permitted use is a disruption to the class and will be treated accordingly.

Hunter College Policy on Academic Integrity:

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures. Plagiarism, dishonesty, or cheating in any portion of the work required for this course will be punished to the full extent allowed according to Hunter College. Being in college requires discipline, collegiality, and overall honesty.

Although knowledge is an accumulation of ideas from different people and epochs that you can use, you have to do so under certain conditions. If you are going to use another's ideas you have to identify their names and works. If you don't, it is called 'plagiarism,' and that is illegal. Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations of the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism. Students who are unsure how and when to provide documentation are advised to consult with their instructors.

ADA Policy:

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical, and/or Learning) consult the Office of AccessABILITY, located in Room E1124, to secure necessary academic accommodations. For further information and assistance, please call: (212-772-4857)TTY or (212-650-3230).

Students requiring special consideration during the exams must make arrangements with the Office of Accessibility and tell your instructor of the arrangements.

Hunter College Policy on Sexual Misconduct:

“In compliance with the CUNY Policy on Sexual Misconduct, Hunter College reaffirms the prohibition of any sexual misconduct, which includes sexual violence, sexual harassment, and gender-based harassment retaliation against students, employees, or visitors, as well as certain intimate relationships. Students who have experienced any form of sexual violence on or off campus (including CUNY-sponsored trips and events) are entitled to the rights outlined in the Bill of Rights for Hunter College.

- a. Sexual Violence: Students are strongly encouraged to immediately report the incident by calling 911, contacting NYPD Special Victims Division Hotline (646-610-7272) or their local police precinct, or contacting the College’s Public Safety Office (212-772-4444).
- b. All Other Forms of Sexual Misconduct: Students are also encouraged to contact the College’s Title IX Campus Coordinator, Dean John Rose (jtrose@hunter.cuny.edu or 212-650-3262) or Colleen Barry (colleen.barry@hunter.cuny.edu or 212-772-4534) and seek complimentary services through the Counseling and Wellness Services Office, Hunter East 1123.

CUNY Policy on Sexual Misconduct Link:

<http://www.cuny.edu/about/administration/offices/la/Policy-on-Sexual-Misconduct-12-1-14-with-links-pdf>

Schedule of Topics and Assignments*

*Except for changes that substantially affect implementation of the evaluation statement, this syllabus is a guide for the course and is subject to revision by the instructor. Any changes will be announced in advance.

Course Contents and Calendar:

Part I: Course Introduction and the Meaning of Science

Week 1:

August 27th (Tuesday): Introduction

1. Syllabus presentation and the description of the assignments
2. Science and the Scientific Method
3. Testing a Theory: “The String Theory”
4. Scientific Perspectives of Nature

Required Materials:

- Bradford, Alina (2015). “Science & the Scientific Method: A Definition.” *Livescience* (March 30). Available at <http://www.livescience.com/20896-science-scientific-method.html>
- Ellis, George (2014). “Defend the Integrity of Physics.” *Nature* (Dec. 18/25), Vol. 516, pp.: 321-323
- Prothero, Donald R. and Dott, Jr., Robert H. (2002). Chapter 2 “Foods, Fossils, and Heresies” in *Evolution of the Earth* (Sixth edition) (read pages 25-36)

Part II: Hazards, Nature, and Its Ecological Construction:

August 30th (Friday):

1. What is a Hazard?
2. Hazard: myths, science, and perception
3. Hazard management and environmental principles

Required Materials:

- Chapter 1: “The Geologic Hazards of Living on Earth” in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)
- Kaufman, Leslie (2012). “Wind Turbines and Health Hazards.” *The New York Times* (Jan. 18). Available at <https://green.blogs.nytimes.com/2012/01/18/wind-turbines-and-health-hazards/>
- Slovic (1987). “Perception of Risk.” *Science*, Vol. 236, issue 4799 (April 17), pp.: 280-285
- The Lisbon Earthquake in “The Engines of Our Ingenuity: No. 1964: Lisbon Earthquake” by Rob Zaretsky. Available at <http://www.uh.edu/engines/epi1964.htm>

PART III: Earth’s Internal and External Structure, Volcanism, and Earthquakes

Week 2:

September 3rd (Tuesday):

1. Earth’s Internal Structure
2. Tectonic Plates Dynamics

Required Materials:

- Marshak, Stephen and Rauber, Robert (2017). Chapter 2: “The Way the Earth Works” in *Earth Science: Advanced Review Copy*

September 6th (Friday): Tectonic Plates and Volcanism

1. Volcanism and Its Hazards
2. Historical Cases:
 - Vesuvius, Italy (79)
 - Tambora, Indonesia (1815)
 - Eyjafjallajökull eruption (2010)

Required Materials:

- “A Day in Pompeii - Full-length animation” (video). Available at https://www.youtube.com/watch?v=dY_3ggKg0Bc
- British Geological Service (2016). “Eyjafjallajökull eruption, Iceland | April/May 2010.” Available at http://www.bgs.ac.uk/research/volcanoes/icelandic_ash.html
- Chapter 2, “Earth’s Interior,” and chapter 4, “Volcanic Hazards,” in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)

Further Materials:

- Herzog, Werner (2016). “Into the Inferno.” (Film) (watch on your own)

Week 3: Earthquake Dynamics:

September 10th (Tuesday):

1. Earthquakes and their Mechanics
2. Tsunamis

Required Materials:

- Chapter 5, “Earthquake Hazards” in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)
- Press, Frank and Siever, Raymond (n. d.). Chapter 18, “Earthquakes” in *Understanding Earth*

Further Materials:

- National Geographic (2011). "Rare Video: Japan Tsunami | National Geographic" [video]. Available at <https://www.youtube.com/watch?v=oWzdgBNfhQU>

September 13th (Friday):

1. Earthquakes, Hazards, and Prevention
2. Historical Cases: Mexico D.F. earthquake (2017)
3. Oklahoma, Hydraulic Fracturing, and Earthquakes

Required Materials:

- Agren, David, Lakhani, Nina, Carroll, Rory, and Jones, Sam (2017). "At least 225 dead after powerful earthquake hits central Mexico" *The Guardian* (Sep. 20). Available at <https://www.theguardian.com/world/2017/sep/19/mexico-city-earthquake-anniversary-1985>
- Chapter 5, "Earthquake Hazards" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)
- Hugo, Kristine (2016). "Earthquakes triggered by fracking, not just wastewater disposal, study finds." *PBS* (Nov. 18). Available at <https://www.pbs.org/newshour/science/earthquakes-triggered-by-fracking>

PART IV: Atmospheric Hazards and Wild Fires

Week 4:

September 17th (Tuesday):

1. Hurricanes and their dynamics
2. Tornadoes

Required Materials:

- Chapter 16: "Severe Weather Hazards" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)
- NOAA (2013). "The Galveston Hurricane of 1900." Available at <http://oceanservice.noaa.gov/news/features/sep13/galveston.html>

Further Materials:

- NASA (2017). "Smoke and Fires Light Up Pacific Northwest." Available at <https://www.nasa.gov/image-feature/goddard/2017/smoke-and-fires-light-up-pacific-northwest>

September 20th (Friday): Wild Fires

1. What is a Wild Fire?
2. Wild Fires and its Hazard
3. Cases: the Pacific Northwest and California

Required Materials:

- Chapter 16, "Wild Fires."
- NASA (2017). "Smoke and Fires Light Up Pacific Northwest." Available at <https://www.nasa.gov/image-feature/goddard/2017/smoke-and-fires-light-up-pacific-northwest>
- The New York Times*. "Where the Fires Are Spreading in Southern California." Available at <https://www.nytimes.com/interactive/2017/12/06/us/southern-california-wildfires.html>

PART V: Hydrospheric Hazards

Week 5:

September 24th (Tuesday): Streams and Floods:

1. Watersheds and the riparian ecosystems
2. Floods, causes, and flood control mechanisms

Cases:

- Mississippi River (historical floods)
- Jökulhlaup, Iceland (1996)

Required Materials:

- Chapter 7: "Streams" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995) (posted on Blackboard)
- ESA (2017). "Vatnajökull flooding - Iceland, 1996." Available at <https://earth.esa.int/web/earth-watching/natural-disasters/volcanoes/content/-/article/vatnajokull-flooding-iceland-1996>
- Livescience* (2011). "Mightiest Floods of the Mississippi River." Available at <http://www.livescience.com/30395-mississippi-river-biggest-floods-110503.html>

September 27th (Friday): Coastal Areas and Hazards:

1. Coastal geomorphology, ocean processes, and human interference
2. Coastal recovery methods
3. Mangrove wetlands

Case:

- Sundarbans and Rampal Power Plant

Required Materials:

- Chapters 14 and 15: "Problems of Mangrove Wetlands and Coral Reefs" and "Coastal Problems" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)
- Harvey, Chelsea (2016). "A new power plant could devastate the world's largest mangrove forest." *The Washington Post* (July 18th). Available at <https://www.washingtonpost.com/news/energy-environment/wp/2016/07/18/a-new-power-plant-could-devastate-the-worlds-largest-mangrove-forest/>
- UNESCO, World Heritage Centre (2016). "The Sundarbans." Available at <http://whc.unesco.org/en/list/798>

Week 6:

October 1st (Tuesday): NO CLASS

Part VI: Mass Movement and Hazards

October 4th (Friday): Landslides

1. Mass Movement
2. What are Landslides?
3. Hazards, Prevention, and Mitigation

Required Materials:

- Chapter 9: "Landslides" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)

PAPER PROPOSAL DUE

Week 7:

October 8th (Tuesday): NO CLASS

Part VII: Understanding the Current Ecological Crisis

October 11th (Friday): Climate Change: Facing the *Unknown*

1. What is *that* so-called Climate Change and Global Warming?
2. Past Climates
3. Causes of Climate Change

Required Materials:

-Chapter 16: "Climate Changes: Past and Future." *Understanding Weather and Climate* (5th Edition). Edward Aguado and James E. Burt

Week 8:

October 15th (Tuesday): Consequences of Climate Change

1. Sea Level Rise: Causes, consequences, and management strategies
Cases: Rotterdam, Netherlands, the North Sea, NYC, and others
2. Extreme weather
3. Environmental Refugees

Required Materials:

a. For Sea level rise in general, see:

-NASA (2018). "Sea Level." Available at <https://climate.nasa.gov/vital-signs/sea-level/>

-NOAA (2017). "Climate Change: Global Sea Level." Available at <https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level>

b. For Rotterdam, the Netherlands, North Sea, NYC, and others:

-Goodell, Jeff (2017). "Rotterdam has learned to cope with rising seas. Here's how." Available at <https://www.vox.com/energy-and-environment/2017/11/15/16651460/rotterdam-climate-change-sea-level-rise>

-Hall, Alexander (2013). "The North Sea Flood of 1953" in *Arcadia*, no. 5. Available at <http://www.environmentandsociety.org/arcadia/north-sea-flood-1953>

-Tam, Laura (2009). "Strategies for Managing Sea Level Rise." Available at <http://www.spur.org/publications/urbanist-article/2009-11-01/strategies-managing-sea-level-rise>

-"The Big U." Available at

<http://www.rebuildbydesign.org/our-work/all-proposals/winning-projects/big-u>

c. For Climate Change and extreme weather, see:

-*The Guardian* (2017). "Climate change made Lucifer heatwave far more likely, scientists find." Available at

<https://www.theguardian.com/world/2017/sep/27/climate-change-made-lucifer-heatwave-far-more-likely-scientists-find>

-*ScienceDaily* (Jan. 18, 2018). "Jet stream changes since 1960s linked to more extreme weather." Available at <https://www.sciencedaily.com/releases/2018/01/180112091209.htm>

D. For Climate Change/Environmental Refugees:

-Taylor, Matthew (2017). "Climate change 'will create world's biggest refugee crisis'." *The*

Guardian (Nov. 20. Available at <https://www.theguardian.com/environment/2017/nov/02/climate-change-will-create-worlds-biggest-refugee-crisis>)

October 18th (Friday): MID-TERM

Part VII. Environmental/Technological Hazards

Week 9:

October 22nd (Tuesday): Dams and Hazards

1. Dams: Types, Uses, and Construction
2. Failures, Safety, and Infrastructure

Cases:

- a. The Johnstown Flood, Pennsylvania
- b. The Vajont Dam, Italy
- c. The Oroville Dam, California

Required Materials:

- Pupovac, Jessica (2015). "Aging and Underfunded: America's Dam Safety Problem, In 4 Charts." *NPR*, WNYC Radio (Oct. 11). Available at <http://www.npr.org/2015/10/11/447181629/aging-and-underfunded-americas-dam-safety-problem-in-4-charts>
- Vartabedian, Ralph (2018). "Human error played a role in Oroville Dam spillway failure, report finds." *Los Angeles Times* (Jan. 5). Available at <https://www.youtube.com/watch?v=C0EgzJ0KGxg>

October 25th (Friday): Nuclear Energy and Hazards:

1. What is Nuclear Energy? Fission, Fusion, and Radioactivity
2. Nuclear Residual Materials
3. Nuclear Reactor Accidents

Cases: Three Mile Island, Chernobyl, and Fukushima

Required Materials:

- "Nuclear Reactor - Understanding how it works" (video). Available at <https://www.youtube.com/watch?v=1U6Nzcv9Vws>
- Reisser, Wesley and Reisser, Colin (2019). Chapter 6, "Nuclear Power" in *Energy Resources: From Science to Society*

Week 10: Waste Disposal

October 29th (Tuesday):

1. Garbage: Landfills, Incineration, and Recycling
2. Sewage
3. Mining Acid Drainage
4. Hazardous Liquid Waste

Required Materials:

- Chapter 12: "Waste Disposal" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)

November 1st (Friday):

1. Plastics/Microplastics
2. E-waste
3. *Cloud* garbage: Virus, Spams, and Trojans

Required Materials:

- Browne, Mark Anthony, Crump, Phillip, Niven, Stewart, Teuten, Emma, Tonkin, Andrew, Galloway, Tamara, and Thompson, Richard (2011). "Accumulation of Microplastic on Shorelines Worldwide: Sources and Sinks." *Environmental Science & Technology* DOI: 10.1021/es201811s
- Chapter 12: "Waste Disposal" in *Geohazards: Natural and Human* by Nicholas K. Coch (1995)
- Chen, Thomas and Robert, Jean-Marc (2004). "The Evolution of Viruses and Worms." Chapter from *Statistical Methods in Computer Security*. Available online at <http://vxheaven.org/lib/atc01.html>

Week 11: Petroleum

November 5th (Tuesday): Understanding Petroleum

1. Geological Formation
2. Physical Qualities of Petroleum
3. Extraction, Transportation, Refining, and Consumption

Required Materials:

- Reisser, Wesley and Reisser, Colin (2019). Chapters 4 and 5, "Oil" and "Natural Gas." in *Energy Resources: From Science to Society*

November 8th (Friday): Petroleum and its Hazards

1. Oil Spills
2. The New Arctic Exploitation
3. Pipelines and trains

Required Materials:

- Brown, Matthew (2018). "US miscalculated benefits of oil train brakes" *AP* (December 20). Available at <https://www.apnews.com/2e91c7211b4947de8837ebeda53080b9>
- Chang, Stephanie E. et al. (2014). "Consequences of oil spills: a review and framework for informing planning." *Ecology and Society* 19 (2): 26. <http://dx.doi.org/10.5751/ES-06406-190226>. Available at <https://www.ecologyandsociety.org/vol19/iss2/art26/>
- Kaushik, Mohit (2018). "Major Oil Spills of the Maritime World." *Marine Environment* (March 26). Available at <https://www.marineinsight.com/author/mohitk/>
- National Geographic (2016). "In the Arctic's Cold Rush, There Are No Easy Profits." Available at <https://www.nationalgeographic.com/magazine/2016/03/new-arctic-thawing-rapidly-circle-work-oil/>
- Smith, Mitch and Bosman, Julie (2017). "Keystone Pipeline leaks 210,000 gallons of oil in South Dakota." *The New York Times* (Nov. 16). Available at <https://www.nytimes.com/2017/11/16/us/keystone-pipeline-leaks-south-dakota.html>

Week 12: Coal and Its Hazards

November 12th (Tuesday):

1. Geological Formation

2. Coal and Its Physical Qualities
3. Mining, Transportation, Production, and Consumption

Required Materials:

-Reisser, Wesley and Reisser, Colin (2019). Chapter 3, "Coal" in *Energy Resources: From Science to Society*

November 15th (Friday): Coal and Its Hazards

Required Materials:

- Berkes, Howard (2018). An Epidemic Is Killing Thousands Of Coal Miners. Regulators Could Have Stopped It." *NPR* (December 18) (also audio). Available at <https://www.npr.org/2018/12/18/675253856/an-epidemic-is-killing-thousands-of-coal-miners-regulators-could-have-stopped-it>
- Scientific American* (2017, Jun. 7). "The Other Reason to Shift away from Coal: Air Pollution That Kills Thousands Every Year." Available at <https://www.scientificamerican.com/article/the-other-reason-to-shift-away-from-coal-air-pollution-that-kills-thousands-every-year/>
- Wong, Edward (2014). "China Exports Pollution to U.S., Study Finds." *The New York Times* (Jan. 20). Available at <https://www.nytimes.com/2014/01/21/world/asia/china-also-exports-pollution-to-western-us-study-finds.html>

FINAL PAPER DUE

Week 13: From Electric Blackouts to Invasive species and GMOs

November 19th (Tuesday): Our Civilization and its Electric Dependency

1. The Electric Grid
2. Blackouts and Their Hazards

Required Materials:

- "How Does the Power Grid Work?" (Video). Available at <https://www.youtube.com/watch?v=IZz4sR5vfeo>
- Minkel, JR. (2008). "The 2003 Northeast Blackout--Five Years Later." *Scientific American* (Aug.13). Available at <https://www.scientificamerican.com/article/2003-blackout-five-years-later/>

November 22nd (Friday):

1. Genetic Modified Organisms (GMOs)
2. Invasive Species

Required Materials:

- Democracy Now* (2010, Sept. 17). "Percy Schmeiser vs Monsanto: The Story of a Canadian Farmer's Fight to Defend the Rights of Farmers and the Future of Seeds." Available at https://www.democracynow.org/2010/9/17/percy_schmeiser_vs_monsanto_the_story
- Gallegos, Jenna (2017). "GMO salmon caught in U.S. regulatory net, but Canadians have eaten 5 tons." *The Washington Post* (August 4). Available at https://www.washingtonpost.com/news/speaking-of-science/wp/2017/08/04/gmo-salmon-caught-in-u-s-regulatory-net-but-canadians-have-eaten-5-tons/?utm_term=.1695ac7c0ebc
- U.S. Environmental Protection Agency (EPA) (2018). "Predicting Invasive Species in the Great Lakes." Available online at http://www.epa.gov/research/gems/scinews_great_lakes.htm

Part VIII. Extraterrestrial Hazards: Asteroids and Comets

Week 14:

November 26th (Tuesday):

1. Main Characteristics of Asteroids and Comets
2. Historical Cases
3. Asteroids, Comets, and Extinction

Required Materials:

- David, Leonard (2019). "Huge Meteor Explosion a Wake-Up Call for Planetary Defense." *Scientific American* (March 21). Available at <https://www.scientificamerican.com/article/huge-meteor-explosion-a-wake-up-call-for-planetary-defense/>
- Malik, Tariq (2018). "A Tiny Asteroid Just Hit Earth, Sparking a Fireball Over South Africa (Video)." *Space.com*. Available at <https://www.space.com/40783-tiny-asteroid-hits-earth-2018-1a-video.html>
- NASA (2008). "The Tunguska Impact-100 Year Later." Available at https://science.nasa.gov/science-news/science-at-nasa/2008/30jun_tunguska

November 29nd (Friday): **NO CLASS THANKSGIVING PERIOD**

Week 15:

December 3rd (Tuesday): Meditations about Planetary Hazards and the Current Ecological Crisis: Final Class Discussion

December 6th (Friday): **Presentations 1**

Week 16:

December 10th (Tuesday): **Presentations 2**

December 13th (Friday): Reading Day

Week 17:

December 17th (Tuesday): **FINAL EXAM**