NTRES 1101:
Introduction to Environmental Science and Sustainability

COURSE INFORMATION

Lectures:	Tuesday and Thursday 9:05 - 9:55 A106 Corson Hall (Morison Room)
Discussion Sections	1:25 – 2:15 Wednesday ***or*** 2:30 – 3:20 Wednesday (rooms will be assigned)
Field Trip (required):	Noon – 3:00 pm, Saturday, Aug. 25th Meet at front door of Fernow Hall
Teaching Assistants:	Bryant Dossman bd342@cornell.edu Jordan Garcia jg2266@cornell.edu Ben Marcy-Quay bm455@cornell.edu
Readings:	Readings will be posted on the course Blackboard site (http://blackboard.cornell.edu/), with the exception of chapters from the book "Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy (2006)" by Alfred W. Crosby (W.W. Norton publisher). You will need to obtain that book on your own.
Grading:	**Class Participation & Assignments** (30% of grade): Journal entries, assignments, discussion section and field trip participation **Midterm Take-Home Exam** (35% of grade) **Final Take-Home Exam** (35% of grade)
Office Hours:	Bryant Dossman: Tuesday 10-11 in Fernow 302 or by appointment Jordan Garcia: Friday 11 – noon in Corson E347 or by appointment Ben Marcy-Quay: Thursday 1 – 2 in Fernow 301 or by appointment Cliff Kraft: Wednesday 10-11 am in Fernow 203, or by appointment

COURSE OVERVIEW & EXPECTATIONS

This course will examine two fundamental questions about the biological, chemical and physical processes that influence the biosphere. First, how do humans **obtain** knowledge about these environmental processes? Second, how can we **assess** human influences upon these environmental processes? We focus on topics from the physical, chemical and biological sciences that establish a foundation for sustainably using environmental resources. Course material will examine how we evaluate claims, assess trends, use evidence, develop models, and evaluate the credibility of information about environmental processes. We will pursue this understanding by examining human impacts on a variety of environmental resources. Course activities throughout the semester will provide a foundation for understanding how natural systems influence and are influenced by human activities. NTRES 1101 is the first in a two-semester sequence of introductory courses required for students following the curriculum in the Environmental and Sustainability Sciences major, the second of which − Society and Natural Resources (NTRES 2201) − will provide an introduction to the theory and approaches that social scientists use to understand, address and manage environmental problems.

A key conceptual framework for NTRES 1101 is that environmental science provides tools for mapping today into tomorrow; that is, environmental science encompasses approaches to understand ongoing trends in environmental conditions that provide an ability to predict the future state of the earth's environment. This framework also links environmental science and sustainability, which addresses the desire to sustain environmental resources for future use and stewardship by humans. As examples, environmental scientists aim to sustain resources such as air and water quality, fisheries harvests, biotic diversity and the productivity of land to produce food and plant products. Attempting to sustain these resources forever requires being able to predict endless future states given our understanding of current trends and conditions. During the semester we will ponder the challenges inherent in that notion of sustainability.

The following ***core processes*** within the natural sciences provide a foundation for the broad array of topics underlying environmental science and resource management. Although this course does not focus on these processes in depth, they will inform course discussions:

- ***Physical processes*** – gravity, heat, energy flow, fluid flow (movement of water, air & accompanying constituents), plate tectonics, thermodynamics
- ***Chemical processes*** – chemical bonding, chemical reactions, phase changes, geochemical equilibria
- ***Geological processes*** – plate tectonics, geomorphology, geochemical reactions, erosion, sedimentation
- ***Biochemical transformations*** – cell- and organism-mediated processes that impact water, air, soil, and sediments; biogeochemistry
- ***Ecological interactions*** – between organisms, and between organisms and their environment
- ***Evolution*** – change in a population's gene pool by natural selection

In addition, the following ***categories of human impacts on the Earth system*** – all of which result from human behavior and actions – will be explored as a framework to understand the ways in which humans alter the core processes underlying environmental science:

- ***Exploitation of biological resources*** (fisheries, forests, wild plants & animals for human use)
- ***Land use and habitat modification*** (food production, human habitation, extraction of energy & mineral resources)
- ***Alteration of biogeochemical cycles*** (greenhouse gas emissions, nutrient cycling)
- ***Alteration of physical processes*** (climate & hydrology)
- ***Human influences on the movement & distribution of living organisms*** (invasive organisms, fragmented and restricted populations, habitat modification)
- ***Aggregation & accumulation of unique (i.e. human produced) or rare compounds*** (e.g. lead, mercury, radioactive elements, endocrine disrupters, halogenated organic compounds)

General Course Structure:

All students are expected to attend class lectures held from 9:05 - 9:55 a.m. each Tuesday and Thursday throughout the semester. Lecture periods will often include in-class discussions or activities requiring active participation by students.

Students are also expected to attend discussion sections at either 1:25 – 2:15 or 2:30 – 3:20 each Wednesday (see Wednesday Discussion Schedule).

The course uses Cornell's Blackboard system http://blackboard.cornell.edu to provide access to course materials, therefore it will be essential for you to visit the website regularly. You will be expected to post responses to questions via Blackboard, as well as download assigned readings and assignments.

Assignments and Grading:

- **Class Participation & Assignments (30% of course grade):**
  - You will complete assignments throughout the semester in response to "prompt" questions via Blackboard. These questions will ask you to provide a written response that reflects upon assigned readings associated with class sessions.
  - Assignments will be graded by course TAs as not completed (0 points), completed but cursory (1 point), thoughtful response (2 points) and exceptional response (3 points).
  - Discussion sections will give you an opportunity to debate ideas, raise questions, and engage in debate as a small group. However, these groups only thrive when all students actively participate, so the TAs will keep weekly notes about student participation in their sections. This record of participation will support a subjective evaluation at the end of the semester

noting whether students almost never participated in discussion, infrequently participated, or consistently participated in a constructive manner.

- **Mid-term Examination (35% of course grade):** This examination will be available as a take-home exam on October 11th, which will be due at 9 pm on Monday, October 22nd. Short essay questions will focus on topics presented in course lectures, readings, discussion sessions, and field trips.

- **Final Exam (35% of course grade):** This examination will be given as a take-home exam on December 4th, which will be due on December 12th at 4:30 pm. Short essay questions will focus on topics addressed in course lectures, readings, and discussion sections.

Late assignments will not be accepted without prior notification. Exceptions will be made only for illness and other challenging circumstances beyond your control. You must contact your lead TA if you know ahead of time that you cannot complete an assignment on time, and you will be required (with instructor consent) to arrange an alternative due date. If extenuating circumstances (e.g. illness or other challenges) unexpectedly interfere with your ability to turn in an assignment at the last minute, contact your TA as soon as possible to explain the situation and arrange for an alternative due date.

Course Learning Outcomes:

Students will be able to:

- Outcome 1: **Describe how humans obtain knowledge about core environmental processes.**

- Outcome 2: **Evaluate the credibility of information about environmental processes and future trends in environmental resources.**

- Outcome 3: **Develop an argument assessing evidence in support of a claim about human influences upon core environmental processes.**

- Outcome 4: **Evaluate information regarding the status of key environmental resources that sustain life.**

Academic Integrity: All students are expected to adhere to the University's Code of Academic Integrity (http://cuinfo.cornell.edu/Academic/AIC.html), which states that any submission of work by a Cornell student for academic credit indicates that the work is the student's own. All outside assistance should be acknowledged and truthfully reported in all circumstances. Students in this class who violate the code will be given a grade of zero for the assignment and/or a failing grade for the course.

During the first two weeks of class we require you to complete a short set of instructional materials and questions ("Recognizing and Avoiding Plagiarism") to make sure that you understand the Cornell plagiarism and academic integrity guidelines.

Sharing of Course Notes: We follow university policy which stipulates that students are not authorized to replicate, reproduce, copy or transmit lectures and course materials presented, or derivative materials including class notes, for sale or distribution to others without the written consent of the instructors who are the original source of the materials.

Disabilities: We will make appropriate accommodations for students with disabilities. Please make such requests during the first three weeks of the semester, except for unusual circumstances, so that arrangements can be made. Students are encouraged to register with Student Disability Services (http://sds.cornell.edu/students.html) to verify their eligibility for appropriate accommodations.

Poll Everywhere: We will use the ***Poll Everywhere*** classroom response system for in-class polling using your own mobile device. During some lectures you will be asked to respond to questions. Instructions and a link to register to the course *Poll Everywhere* account are available below and on the NTRES 1101 Blackboard site. You will need to bring to class a cell phone, tablet, iPad, or laptop computer that will allow you to either text message or respond via the web. You must log in during class. Otherwise, your responses will not be recorded.

To register for *Poll Everywhere*:

- Go to: http://tinyurl.com/ntres1101. You will be asked to **provide your name and Cornell email address** (other email addresses will not be accepted in the course). Create a unique password.

- **To use your cell phone** to text the Poll Everywhere responses, you must enter and certify your cell phone number in your profile (www.polleverywhere.com/profile/edit) to ensure that you receive credit for responding.

- When you use a computer, you will need to sign in before the first poll of the day in the upper-right corner of the *Poll Everywhere* page. This will ensure that you receive credit for responding. Signing in is your responsibility. During class lecture, questions will appear on www.pollev.com/ntres1101.

- **If you have any questions** please visit the *Poll Everywhere* User Guide (www.polleverywhere.com/guide) or contact a course Teaching Assistant.

COURSE TOPICS, SCHEDULE & ASSIGNED READINGS

Class sessions meet at 9:05 – 9:55 am, in

Date	Topic	Readings
Thurs, 8/23	Why environmental science matters	
Tues, 8/28	What is an environmental problem?	• Young, R.S. (2017). An Evaluation of the Ongoing Impacts of Sand Mining at the CEMEX Lapis Sand Plant in Marina, California on the Southern Monterey Bay Shoreline (unpublished report) • Thornton et al. (2006) Sand mining impacts on long-term dune erosion in southern Monterey Bay. Marine Geology 229:45- 58
Thurs, 8/30	Sustainability close at hand	• Kates, R.W. (2011). What kind of a science is sustainability science? Proc. Nat. Acad. Sci. USA 108:19449-19450 • Zencey, E. (2010). Theses on sustainability: A primer. Orion. May/June 334-337.
Tues, 9/4	Scientific Method: Four Bold Claims (Guest Lecture: Dylan Bugden)	• Gauch, H.G. (2012). Four Bold Claims (chapter 2, pp. 21-33). *In* The Scientific Method in Brief. Cambridge University Press. • The logic of scientific arguments (https://undsci.berkeley.edu/article/howscienceworks_07)
Thurs, 9/6	Scientific Method: Science's Contested Rationality (Guest Lecture: Dylan Bugden)	• Achenbach, J. (2015). Why do many reasonable people doubt science? National Geographic. • How to talk to someone who doesn't believe in climate change (https://ideas.ted.com/how-to-talk-to-someone-who-doesnt-believe-in-climate-change/)
Tues, 9/11	Signal and Noise	• Silver, N. (2012). "Introduction" (pp. 1 -17) and "For Years You've Been Telling Us That Rain is Green" (Chapter 4, pp. 108-141). *In* The Signal and the Noise. Penguin Press.
Thurs, 9/13	Assessing trends, causation & evidence	• Chamberlin, T.C. (1890). Method of multiple working hypotheses. Science 148: 754-759. • Railsback, L.B. (2004). Summary of Chamberlain • Findings of fact and conclusions of law and memorandum order. U.S. U.S. District Court Western District Court of Washington at Seattle. No. C70-9213, Subproceeding No. 09-01. pp. 1-13.
Tues, 9/18	The origin of information and concepts	• Martin, L.J. (2018). "Proving grounds: ecological fieldwork in the Pacific and the materialization of ecosystems," Environmental History 23: 567–592 • Yoon, C.K. (2009). "The Strange Case of the Fish that Wasn't" (Chapter 1, pp. 3-22). *In* Naming Nature: The Clash Between Instinct and Science. Norton Press.

Date	Topic	Readings
Thurs, 9/20	Where does scientific information come from?	• Hesse-Honegger, C. & Wallimann, P. (2008). Malformation of True Bug (Heteroptera): a Phenotype Field Study on the Possible Influence of Artificial Low-Level Radioactivity. Chemistry and Biodiversity 5:499-539. • Raffles, H. (2010). A conjoined fate. Orion (Jan/Feb) 16-27.
Tues, 9/25	Models, decisions, and managing the environment (Guest Lecture: Evan Cooch)	• Rosenblueth, A. & Wiener, N. (1945). The Role of Models in Science. Philosophy of Science 12:316-321. • Starfield, A.M. (1997). A pragmatic approach to modeling for wildlife management. The Journal of Wildlife Management 61:261-270.
Thurs, 9/27	Risk, rewards & making decisions (Guest Lecture: Evan Cooch)	• Yue, C. (2011). Uncertainty (Chapter 2, pp. 27-49). *In* Principles of Risk Analysis: Decision Making Under Uncertainty. CRC Press.
Tues, 10/2	Are ocean fisheries collapsing?	• Hutchings, J. A., & Myers, R. A. (1994). What can be learned from the collapse of a renewable resource? Atlantic Cod, Gadus morhua, of Newfoundland and Labrador. Canadian Journal of Fisheries and Aquatic Sciences, 51, 2126–2146. • Worm B. et al. (2009). Rebuilding global fisheries. Science 325:578-585.
Thurs, 10/4	Predicting the future	• Silver, N. (2012). Chapter 12: "A Climate of Healthy Skepticism" (pp. 370 -411) *In* The Signal and the Noise. Penguin Press.
Tues, 10/9	No class	
Thurs, 10/11	Acid Rain in the Adirondacks I	• Jenkins, J. et al. (2007). Adirondack Research Begins (Chapter 3, pp. 41-64). *In* Acid rain in the Adirondacks: an environmental history. Cornell University Press
Tues, 10/16	Acid Rain in the Adirondacks II	• Jenkins, J. et al. (2007). The Big Synoptic Surveys (Chapter 4, pp. 65-90). *In* Acid rain in the Adirondacks: an environmental history. Cornell University Press.
Thurs, 10/18	Measurements & models: atmospheric carbon dioxide and climate change	• Keeling, C.D. (1960). The concentration and isotopic abundances of carbon dioxide in the atmosphere. Tellus 12:200-203. • Keeling, C.D. (1970). Is carbon dioxide from fossil fuel changing man's environment? Proc. Am. Philos. Soc. 114:10–17. • Keeling, C.D. (1998). Rewards and penalties of monitoring the earth. Annu. Rev. Energy Environ. 23:25-82.
Tues, 10/23	Balancing greenhouse gas budgets	• Houghton, R.A. (2007). Balancing the global carbon budget. Annu. Rev. Earth Planet. Sci. 35:313–47 • Royal Society and National Academy of Sciences (2014). Climate change evidence & causes. http://dels.nas.edu/resources/static-assets/exec-office-other/climate-change-full.pdf

Date	Topic	Readings
Thurs, 10/25	Fossil fuel and energy use	• Crosby, A. (2006). Preface and Chapters 4 & 5 *In* Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy. First edition. W.W. Norton. • Energy Information Administration (2018). Introductory pages (1-32) from Annual Energy Outlook 2018 https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf
Tues, 10/30	Energy use and argument	• Idso, C.D et al. (2017). Why scientists disagree about global warming. The Heartland Institute. Arlington Heights, IL USA. https://www.heartland.org/publications-resources/publications/why-scientists-disagree-about-global-warming • The scientific guide to global warming skepticism https://skepticalscience.com/docs/Guide_to_Skepticism.pdf
Thurs, 11/1	Cayuga Lake and Cornell campus energy use	• Crosby, A. (2006). Chapter 6 *In* Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy. First edition. W.W. Norton.
Tues, 11/6	Human impacts on the Earth system	• Crosby, A. (2006). Chapters 1 & 2 *In* Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy. First edition. W.W. Norton. • Kolbert, E. (2013). The lost world: fossils of the future. The New Yorker 89: 48–56.
Thurs, 11/8	Anthropogenic biomes (anthromes)	• Smith, B.D. (2007) Ultimate ecosystem engineers. Science 315: 1797-1798 • Ellis, E.C. & Ramankutty, N. (2008). Putting people in the map: anthropogenic biomes of the world. Front. Ecol. Environ. 6, 439–447
Tues, 11/13	Mid-term exam results Evolution & ecology in action: Invasive species	• Crosby, A. (2006). Chapter 3 *In* Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy. First edition. W.W. Norton. • Thomas, C.D. (2017). Prologue (pp. 3-9) and Biogenesis: Gains and Losses (pp. 11-25) *In* Inheritors of the Earth. Perseus Books.
Thurs, 11/15	Evolution & ecology in action: Why does biodiversity matter?	• Vellend (2017. The Biodiversity conservation paradox. American Scientist 105:94-101.
Tues, 11/20	Sustainability & Thanksgiving	• *No reading assignment*
Tues, 11/27	Carrying capacity: How do we know when we're running out of resources?	• *No reading assignment*
Thurs, 11/29	Environmental science in the real world (Guest Lecture: Mike Rolband)	• *No reading assignment*
Tues, 12/4	The future of environmental science and management	• Donlon et al. (2005). Re-wilding North America. American Naturalist 168: 660-681

Wednesday Discussion Section & Field Trip Schedule

Sat, 8/25 (noon)	Field Trip: What is a natural environment?
Wed, 8/29	Discussion: What is an environmental problem?
Wed, 9/5	Discussion: The scientific method
Wed, 9/12	Discussion: Forecasting weather: the use of models and data
Wed, 9/19	Discussion: Where do concepts & information come from?
Wed, 9/26	Discussion: Risks, rewards, and making decisions
Wed, 10/3	Discussion: Models in fisheries management
Wed, 10/10	Discussion: How does environmental insight begin?
Wed, 10/17	Discussion: Acid rain as example of success?
Wed, 10/24	Field Trip: Central Energy Plant
Wed, 10/31	Discussion: Evaluating a critique of climate science
Wed, 11/7	Discussion: Human impacts on the Earth system
Wed, 11/14	Discussion: Invasive species in a cultural context
Wed, 11/28	Discussion: Review of course concepts