BIOL/ENST 4470 WA Global Change Biology Course Outline 2017

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Meeting Schedule: Mondays and Wednesdays 11:30 am – 1:00 pm in RB-2024

Office Hours: Tuesdays and Thursdays 11:30 am – 12:30 pm

Evaluations of Marks: The course uses a combination of lectures, readings, discussions and assignments. Depending on class size, the instructor will evaluate marks based on class discussion participation (15 %), seminar presentation (25 %), formal written report (30 %), and a final exam (30 %).

Course Description: An examination of how biological systems both respond and cause global environmental change. Biological systems are viewed within the context of complexity theory, ecological interactions and evolutionary change. Focus is placed on how past environmental discontinuities and trends have affected evolution of life and biodiversity. Emphasis is placed on the history of human population growth and how its biophysical and socioeconomic development has become the dominant driver of environmental change affecting all life and may be causing the sixth mass extinction in Earth's history. The course welcomes senior students from any discipline and functions as a capstone to prepare graduates to understand and face the most pressing issues affecting the future of all life including our own species.

DetailedDescription: In this course we will study how biological systems are affected by and respond to large-scale environmental change. We will study natural environmental changes and how life has responded to these challenges but special emphasis will focus on how human actions are becoming the major driver of global environmental changes and how they are altering ecosystems and their services, resulting in a loss of biodiversity, and ultimately how the environment in turn is altering human biological and social systems. Although our perspective is on how living systems interact with chasnging environments, we will do so philosophically within the general concept of complex systems theory which applies to the functioning, persistence, and collapse of biological, ecological, physical, and human engineering and social systems. The course uses a combination of lectures, seminars, readings, and discussions and is intended as a capstone course preparing senior students to understand the most important problem(s) facing biological systems and human civilization. The course takes a multidisciplinary approach and welcomes participation of senior students from any academic discipline.

Questions of interest include how organisms, populations, communities, ecosystems, civilizations, organizations, and engineered or social systems respond to environmental change. Of prime importance is understanding how human activities affect or may alter other biological systems in the future through environmental change. What kind of events can affect life on a

global scale? What are the major environmental trends to which life must respond? How well can the future of the biosphere be predicted? What are the most pressing problems facing biological systems and human civilization? We will attempt to answer or at least shed light on these questions in the course.

Other Information: A Desire2Learn website is set up for the course. From this site you can ***view or download the lecture material as PowerPoint files or readings as documents or pdfs***. The grade you ultimately earn depends on the level of your effort. The instuctor will provide advance notice of upcoming topics and disseminate materials via D2L or email. A formula for success involves attending all lectures, completing all assignments on time, reading your text, making good notes, and a sufficient amount of studying. Good attendance in lectures and discussions is important so that you will not miss the review of the basic topics and any additional information and examples that are provided. If you must miss a test or exam because of illness or other serious circumstance, contact the instructor or lab technician as soon as possible (documentation may be required). Cell phones must be turned off and put away during classes unless needed for emergency purposes (see instructor). Laptops, iPads, etc. may be used for notetaking but not for social networking, internet shopping or other personal uses during class. Please also refrain from attending lecture or office hours if you have a contagious illness. After you recover, borrow notes from a classmate or ask the instructor to review what you missed.

Prescription for success: Foremost interest, thinking, and communicating. As your academic career advances you become by default more of an expert in your major. However the world is complex and can only be understood by taking multidisciplinary approaches. Think about how your work fits into the big picture. Do some research, stretch the grey cells, and participate in discussions. While we will be dealing with important and serious issues, let's still have some fun as we learn.

Seminar Presentation: Each student will choose a topic of personal interest within the broad umbrella of global change and provide a 15 – 20 minute PowerPoint presentation. Topic and time slot to be approved by the instructor. The seminar may be accompanied by a selected reading distributed at least a week prior to the presentation. General discussion on the topic and paper will follow.

Formal Written Report: Each student will provide a formal written report on their topic of interest that was presented and discussed. The text of the report should not exceed 10 printed pages of the main text. The paper must be followed by a Literature Cited Section. Use standard sized font and no smaller than 1 inch (2.5 cm) margins. References cited in text should use the following format (Laurel & Hardy 1920) or (Schickelgruber et al. 1938). For the Literature Cited section use the same format as appears in the Key Reference section in this outline. The formal report is to be handed in **no later than the time and date of the last scheduled class**.

Topics of interest include...

- biological systems
- hierachy of biological scale
- biotic and abiotic systems
- key ecological concepts
- fractal structure of the environment
- complex systems theory
- ecological stability, resilience, sustainability
- novel ecosystems
- panarchy
- order & chaos
- catastrophy theory
- Earth history
- climate change
- adaptation to changing environments
- temporal trends of biodiversity
- mass extinctions
- human history
- growth and collapse of civilizations
- anthropogenic effects on environment
    - role in climate change
    - habitat degradation &loss
    - pollution
    - appropriation of resources
    - species introductions
    - emerging infectious diseases
    - species invasions
- alternate futures of the biosphere

Key Resources

Brown, J.H. 1995. Macroecology. University of Chicago Press. 269 pp.

Crosby, A. 1986. Ecological Imperialism: The Biological Expansion of Europe 900-1900. Cambridge University Press.

Diamond, J. 1987. The worst mistake in the history of the human race. Discover, May: 64-66.

Diamond, J. 1997. Guns, Germs, and Steel: The Fates of Human Societies. W.W. Norton, NY.

Diamond, J. 2005. Collapse: How Human Societies Choose to Fail or Succeed. Penguin, London.

Emmott, S. 2013. Ten Billion. Penguin Books, Toronto. 218 pp.

Fagan, B. 2000. The Little Ice Age: How Climate Made History 1300 – 1850. Basic Books, New York. 246 pp.

Fagan, B. 2004. The Long Summer: How Climate Changed Civilization. Basic Books, New York. 284 pp.

Ginsberg, B. 2011. The Fall of the Faculty: The Rise of the All-Administrative University and Why It Matters. Oxford University Press. 248 pp.

Gore, A. 2013. The Future: Six Drivers of Global Change. Random House, New York. 592 pp.

Gunderson, L.H. 2010. Foundations of Ecological Resilience. Edited by Lance H. Gunderson, Craig R. Allen, and C. S. Holling. Island Press. 496 pp.

Gunderson, L.H., and C.S. Holling. 2002. Panarchy: understanding transformations in human and natural systems. Edited with L. Gunderson, (editors) Washington, DC: Island Press.

Hannah, L. 2015. Climate Change Biology, Second Edition. Elsevier Academic Press, Amsterdam. 455 pp.

Hobbs, R. J., S. Arico, J. Aronson, J. S. Baron, P. Bridgewater, V.A. Cramer, P. R. Epstein, J .J. Ewel, C. A. Klink, A. E. Lugo, D. Norton, D. Ojima, D. M. Richardson, E. W. Sanderson, F. Valladares, M. Vila, R. Zamora, and M. Zobel. 2006. Novel Ecosystems: theoretical and management aspects of the new world order. Global Ecology and Biogeography 15:1-7.

Hobbs, R. J., E. Higgs, and J. A. Harris. 2009. Novel ecosystems: implications for conservation and restoration. Trends in Ecology and Evolution 24:599–605.

Holling, C.S. 2008. Discontinuities in Ecosystems and Other Complex Systems. Edited with Craig R. Allen, New York, NY : Columbia University Press.

Homer-Dixon, T. 2006. The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization. Knopf, Toronto.

Johnson, N. 2007. Simply Complexity: a Clear Guide to Complexity Theory. Oneworld Publications, London. 236 pp.

Kolbert, E. 2014. The Sixth Extinction: An Unnatural History. Henry Holt & Co., New York. 319 pp.

Maurer, B.A. 1999. Untangling Ecological Complexity: The Macroscopic Perspective. University of Chicago Press. 251 pp.

McNeill, J.R. 2000. Something New Under the Sun: An Environmental History of the Twentieth-Century World. W.W. Norton & Co., New York. 421 pp.

Mitchell, M. 2009. Complexity: a Guided Tour. Oxford University Press. 349 pp.

Ponting, C. 1991. A Green History of the World: The Environment and the Collapse of Ancient Civilizations. Sinclair-Stevenson, London.

Raup, D.M. 1992. Extinction: Bad Genes or Bad Luck? W.W. Norton & Company, New York, NY.

Richardson, L.F. 1960. Statistics of Deadly Quarrels. Boxwood Press. Pacific Grove, California

Rosen, William. 2014. The Third Horseman: Climate Change and the Great Famine of the 14th Century. Viking , New York. 302 pp.

Smil, V. 2008. Global Catastrophes and Trends: The Next Fifty Years. MIT Press, Cambridge, NY. 307 pp.

Tainter, J.A. 1988. The Collapse of Complex Societies. Cambridge University Press. Cambridge, UK.

Waldrop, M.M. 1992. Complexity: The Emerging Science at the Edge of Order and Chaos. Simon & Shuster. 380 pp.

Wright, R. 2004. An Illustrated Short History of Progress. House of Anansi Press, Toronto.

Tentative Schedule:

1. Introduction – Biological Systems, Complex Systems, Scale, Global Change

2. Biodiversity: Ups & Downs

3. Discontinuities: Rocks & Lava

4. Discontinuities: Bugs & Wars

5. Trends: Climate

6. Origin of Humans and Civilizations

7. Biodiversity and Humans

8. Trends for Humanity

9. Novel Ecosystems

10. TBA

11. TBA

12. TBA