POSC 333-00:
Sustainability Science

Syllabus

Mondays and Wednesdays 1:50p.m – 3:35p.m
March 26 – June 1, 2012

Weitz Center 136

The Department of Political Science
Carleton College, Northfield, MN

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Preface

> "Just providing knowledge, even if communicated well, without offering spaces to discuss the implications, will no longer suffice. If sustainability were something we could achieve by holding hands and singing "kumbaya" despite all our differences, we'd already be there!"
>
> Susanne C. Moser, in IHDP Update, Special Edition, 2008, International Human Dimensions Program (www.ihdp.org)

> "The big question in the end is not whether science can help. Plainly it could. Rather, it is whether scientific evidence can successfully overcome social, economic and political resistance."
>
> Donald Kennedy, *Science Magazine's State of the Planet 2006-2007*

The continual existence and betterment of humankind depends on the ability and intellect of human beings to make educated choices (rightly understood) in living with nature and to govern themselves. At the center of this challenge for human beings in the age of Anthropocene is the need for systematic and scientific understanding of how the dynamic relationship between societal changes and environmental changes influence change, adaptation, and evolution of coupled human-environment systems. This seminar will introduce students to theories, concepts, analytical frameworks, and research designs that will help us advance in understanding the dynamic relationship between societal changes and environmental changes. In so doing, we will study empirical cases and experimental results of real world sustainability problems.

As the two quotes above indicate, understanding dynamics of human-environment interactions is only half way to achieving sustainability of social ecological systems. The additional and more intriguing challenge is in analyzing, explaining, and understanding the circumstances under

which these scientific understandings are translated into public policy and governance of human interactions. Therefore, achieving sustainability of human societies is a dual challenge. This course is conceived within the dual challenge of the need to understand how societal dynamics and environmental dynamics interact over time *and* how they help induce or inhibit sustainability of social ecological systems. For the lack of a better term, scholars who engage in the field of analyzing and explaining these challenges generally call their intellectual endeavor "Sustainability Science."

How do social changes and ecological changes interact? How do livelihood systems of individuals and groups interact with social changes and ecological changes? What are the roles of human institutions and human values in dynamic relationship between social changes and ecological changes? Why is "science" in traditional sense of it insufficient to address sustainability problems? What does "science" mean in sustainability science? How does emergence occur and how does it shape complexity of human-environment relationship? What are existing theories and methods that address sustainability science? How would you improve these theories and methods? How can these theories and concepts guide environmental policy and governance? These questions form a source of intellectual motivation for this seminar.

There are three learning goals in this seminar. First, students will learn key trends of literature that addresses the challenge of the field amplifying the pivotal role of social dimensions in sustainability science. Second, students will gain knowledge of key concepts and theories in sustainability science that are developed and improved by scholars from multiple academic disciplines. Third, students will gain practical experience and skills of linking theories to practices of sustainability challenges by conducting team projects.

In order to achieve these goals, we will actively read and engage our class discussions on the literature on sustainability science from multiple academic disciplines; study cases that illustrate the dual challenge of understanding and developing theories in the field of sustainability science; and conduct team projects that will allow students to analyze, challenge, and develop theories and research methods by linking theories to practices. The seminar is organized with the following outline.

Course Outline

Week One:	Ontological Foundations
Week Two:	Epistemic Foundations
Week Three:	A New Kind of Science
Week Four:	Dynamics and Diversity of Ecosystems
Week Five:	Dynamics and Diversity of Human Institutions
Week Six:	Understanding Social Ecological Transformations
Week Seven:	Collapses and Survival of Social Ecological Systems
Week Eight:	Vulnerability, Adaptation, and Resilience
Week Nine:	Crossing Boundaries and Building Bridges
Week Ten:	Sustainability Science (or) Social Ecological Sciences

Required Texts:

Fritjof Capra, *The Hidden Connection: A Science for Sustainability Living*, Anchor Books, 2002. ISBN 0-385-49472-6 (paperback)

Simon Levin, *Fragile Dominion: Complexity and Commons*, Perseus Publishing, 1999. ISBN: 0-7382-0319-X (paperback)

Lance H. Gunderson and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press, 2002, ISBN: 1-55963-857-5 (paperback)

Donald Kennedy (ed), *State of the Planet 2006-2007*, Island Press, 2006.

In addition to reading chapters from these texts, we will also read articles from peer-reviewed academic journals and also watch documentaries and videos illustrating the concepts we struggle to understand in this course. In addition to readings listed in this syllabus, I have placed additional relevant readings on E-Reserve at the Gould Library. Feel free to browse and read as relevant. Team project related readings will be provided for the teams separately once teams are established.

Expectations, Assignments, and Grading Procedures

The following four components of assignments will be used to evaluate your performance in this seminar. Percentage worth of each assignment is in parentheses. The details of each assignment are below.

1. **Active Reading and Participation (20%)**: Reading assigned materials is crucial for understanding class discussion and cases we will unpack in this seminar. Readings are assigned to be complementary to the class discussion and interactive lectures. In this sense, readings are not substitutable for class discussion and interactive lectures. For each week, active reading questions will be provided which will serve as a guide to active reading. I will send out active reading questions on Fridays. A group of two students will self-assign to lead class discussion for each week. A student must lead two classes, preferably one before mid-term and one after mid-term. You are highly recommended to bring visual materials such as video clips or news articles that relate directly to your discussion questions for the readings. Students will sign up for two dates on March 28 when I will have signup sheet. This component will be worth 10 points out of 20 for this part of seminar. Remaining 10 points will be assigned based on your performance as a responsible citizen of this seminar. To be a good standing citizen of this course, you are required to:(1) have good attendance; (2) read assigned materials before the class; (3) have timely notification and communication with me when you have to be absent or if you need to request extension for personal reasons; and (4) exercise self-respect and responsibility of a student for success of the learning mission of this seminar and

Carleton College as a whole; and (5) exercise your intellectual freedom in discussions and the assignments.

2. **Critical Review of a Documentary Video (15%)**: This assignment requires writing an essay on nature and society interactions. This essay is to critically reflect on complexity of social ecological systems based on class discussion, lectures, and documentary videos we watched over the course of the term. Students will pick one of three movies we watch for the seminar and write a critical and reflective essay on human-environment interactions. In so doing, you are encouraged to draw upon concrete examples or cases that shed light on the concepts you attempt to formulate in your essay. This essay should be between 4 and 6 pages. Students will sign up for the documentary video they plan to review and the review essay is due within seventh day after the designated viewing day in this syllabus. For instance, if you select to review *Life after People* video to be shown on April 8, your review essay is due by no later than April 15 at 5:00p.m.

3. **Livelihood Systems Analysis (25%)**: Each student will recollect items brought to Carleton College in their freshman year and put in a log sheet. Students then will select three items that were deemed necessary (frequently used). After selection of these three items, student will draw a livelihood map of a freshman student life at Carleton College during their respective freshmen years. Key activities that were directly related to the three items must be described, discussed, and analyzed to write about the relationships between an individual livelihood system and the nature. Along with study of their own livelihood systems, students will interview a parent, a relative, a teacher, or a person who went to a college at least 20 years ago and find out what items they brought to their respective college freshman years and what they did with them. If you have parents who did not go to college, ask your uncles or aunts. If none of your relatives went to college in the United States, then conduct an interview with one of your professors, staff members at Carleton or a resident in Northfield. This paper requires a light research yet in-depth investigation of your own livelihood systems and that of one other individual. This paper should be 8 to 10 pages excluding diagram, tables, and references. More detailed guidelines will be provided in a separate handout on April 4. This analysis is due on **May 6 at 5:p.m**.

4. **Group Project (30%):** A team of four students will select a project out of five projects. The **first** project asks: how many trees does the Eastside Neighborhood in Northfield, MN need to sequester all carbon dioxide emitted by human activities of the residents. In answering this question, students will investigate physical science of carbon sequestration, the validity of the question in regard to the purpose of the answer, and legal and policy science aspects of urban trees, city codes, state laws, and federal laws that govern the answer to this question. The **second** project asks: What are the political

and economic consequences of the United States' energy independent status? What does the goal of energy independence require the United States to do? What are the domestic sources of energy? On March 22, 2012, *New York Times* reported that the United States is inching toward goal of energy independence. Students will examine data on consumption of imported energy and its contribution to green house gas emission and economic benefits for related industries. The project requires students to examine political, economic, and scientific dimension of energy independent status for the United States. The **third** project is about the removal of Ames Mills Dam in downtown Northfield, MN. Students will investigate social and ecological consequences of removing AMD. In so doing, students will identify key issues, interests, and actors that are at the center of the removal issue. For the **fourth** project, student will conduct political, economic, and ecological dimensions of of Nissan Leaf and Toyota Prius cars. How would electric and hybrid cars influence global climate change regime? How can we understanding the influence of these cars in daily life of citizens? The **fifth** project will investigate Carleton College's carbon emission data and key areas of Carleton's livelihoods that have largest impact on climate change issue. Final report should be 20 to 25 pages excluding maps, pictures, tables, figures, diagrams, and references. More details about these four projects and project guidelines will be provided on Wednesday April 8 in a separate handout.

IMPORTANT NOTE: All assignments should be written with 12 point Times New Roman font on double-spaced pages with page numbers inserted on 1 inch page margin of A4 size. It is highly encouraged that students use the Write Place or available writing services on campus to achieve high quality product. Electronic copy is acceptable in pdf or rtf format or other read only format. You do not need to submit a hard copy when you send me electronic copy.

Schedule of Assignments and Due Dates

3/28 - Sign up due dates for quantitative and critical review and documentary review
4/2 - Distribute assignments and guidelines for team project
4/15 - Review of *Life After People* is due for students who select to review it
4/22 - Review of *Queen of Tree* is due for students who select to review it
4/24 - Review of *Mystery in Alaska* is due for students who select to review it

MIDTERM BREAK 4/28 – 4/30

5/6 - Livelihood System Analysis paper is due
5/15 - First draft of team paper is due
5/25 - The final draft of team paper is due
5/30 - Team presentations
6/31 - Team presentations …
6/2 - Final team papers are due

Course Conduct

a. Attendance: Attendance is required for this course. If you need to be absent from the class, it is your responsibility to notify me in advance. When you are absent, it is in your benefit to borrow notes from your classmate or ask your classmates to learn what you missed. If you wish, I will be available during office hours or by appointment at your request to meet with you and go over what you missed while you were absent.

b. Plagiarism: There is zero tolerance for plagiarism. A summary of the College's policy on plagiarism states: *"At Carleton College, an act of academic dishonesty is therefore regarded as conflicting with the work and purpose of the entire College and not merely as a private matter between the student and an instructor; all cases involving such dishonesty are referred for appropriate action to the Academic Standing Committee (ASC) via the Associate Dean of Students or the Associate Dean of the College."* For more information on Carleton's policy on academic honesty, please consult http://apps.carleton.edu/campus/dos/handbook/academic_regs/?policy_id=21359

c. Late assignments: Assignments are due on the dates specified in this syllabus or in the assignment sheet. Late work **will receive half point reduction per late day.** If you are unable to complete an assignment on time due to illness or personal emergency, you can request an extension with the supporting documents such as a medical note from a doctor or the Wellness Center.

d. Special needs: If you require special accommodation due to a documented physical or medically classified different learning strategy, please come see me during the first week of class or any time throughout the semester to discuss how I might best assist you in meeting the objectives and requirements of this course.

NOTE: This is a provisional syllabus and subject to change.

Schedule of the Course and Readings

WEEK ONE: ONTOLOGICAL FOUNDATIONS

March 26: Introduction to the Seminar

Essential readings:

This syllabus. Overview and the roadmap of seminar.

March 28: Nature of Life

Essential readings:

Fritjof Capra, 2002, *The Hidden Connections: A Science for Sustainable Living*, Anchor Books.
Chapter 1: The Nature of Life, p. 3-32.
Chapter 3: Social Reality, p. 70 - 96.

James Fowler and Darren Schreiber, 2008, "Biology, Politics, and Emerging Science of Human Nature," *Science*, 322 (November): 912-914.

Daniel Koshland Jr., "The Seven Pillars of Life," 2002, *Science* 295 (March): 2215-2216.

Donald Kennedy, "Life on Human Dominated Planet," Chapter 1 in *State of the Planet 2006-2007*, AAAS, p. 5-12.

WEEK TWO: EPISTEMIC FOUNDATION

April 2: Science and Sustainable Societies

Essential readings:

Fritjof Capra, 2002, *The Hidden Connections: A Science for Sustainable Living*, Anchor Books.
Chapter 4: Life and Leadership in Organizations, p. 97 -128.
Chapter 5: The Networks of Global Capitalism, p. 129 - 157
Chapter 6: Biotechnology at a Turning Point, p. 158 - 185.

Peter H. Raven, "Science, Sustainability, and the Human Prospect" *Science*, Vol. 297, No. 5583 (Aug. 9, 2002), pp. 954-958, **Online:** http://www.sciencemag.org/cgi/reprint/297/5583/954.pdf

April 4: No class. Group project meetings

 **April 8 – Movie screening – Life after People**

WEEK THREE: SOCIAL ECOLOGICAL COMPLEXITY

April 9: Concepts, Theories, and Paradigms of Sustainability

Essential readings:

Partha Dasgupta, "The idea of sustainable development," *Sustainability Science*, 2 (1): 5-11. April 2007.

Frank E. Egler, "Vegetation as an Object of Study," *Philosophy of Science*, 9 (3): 245 – 260, July, 1942.

Dyson, Freeman. 1998. A Science as a Craft Industry. *Science* 280 (May 15): 1,014-15. **Online:** http://www.sciencemag.org/cgi/content/full/280/5366/1014

Robert W. Kates, William C. Clark,* Robert Corell, J. Michael Hall, Carlo C. Jaeger, Ian Lowe, James J. McCarthy, Hans Joachim Schellnhuber, Bert Bolin, Nancy M. Dickson, Sylvie Faucheux, Gilberto C. Gallopin, Arnulf Grübler, Brian Huntley, Jill Jäger, Narpat S. Jodha, Roger E. Kasperson, Akin Mabogunje, Pamela Matson, Harold Mooney, Berrien Moore III, Timothy O'Riordan, Uno Svedin, "Environment and Development: Sustainability Science, *Science*, Vol. 292. no. 5517, pp. 641 – 642, 27 April 2001.

April 11: Fundamental Questions

Essential readings:

Simon Levin, *Fragile Dominion: Complexity and Commons*, Perseus Publishing, 1999.
Chapter 1: Biodiversity and Our Lives, p. 1 – 15.
Chapter 2: The Nature of Environment, p. 17 – 38.
Chapter 3: Six Fundamental Questions, p. 39 – 55.

Ottino, J. M. 2004. "Engineering Complex Systems." *Nature* 427 (January): 399.

April 15: Documentary screening – Queen of Tree

WEEK FOUR: DYNAMICS AND DIVERSITY OF ECOSYSTEMS

April 16: A Mystery or Complexity

Essential readings:

Simon Levin, *Fragile Dominion: Complexity and Commons*, Perseus Publishing, 1999.
Chapter 4: Patterns in Nature, p. 57 – 80.
Chapter 5: Ecological Assembly, p. 81 – 115.
Chapter 6: The Evolution of Biodiversity, p. 117 – 156.

 **April 17: Documentary screening – Mystery in Alaska**

April 18: Ecosystem Rules as Sources of Dynamics and Complexity

Essential readings:

NOTE: Assign Panarchy Chapter 1

Wilson, James. 2002. "Scientific Uncertainty, Complex Systems, and the Design of Common-Pool Institutions," in National Research Council, *The Drama of the Commons*. Washington, D.C.: National Academy Press. pp. 327-60.

Lance H. Gunderson and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press, 2002, ISBN: 1-55963-857-5 (paperback)
Chapter 5: "Back to the Future: Ecosystem Dynamics and Local Knowledge" by Fikret Berkes and Carl Folke, p. 121-146.

Use Thai villagers' research case.

WEEK FIVE: DYNAMICS AND DIVERSITY OF HUMAN INSTITUTIONS

April 23: Foraging Experiment in the Lab at CMC 109

Essential readings:

NOTE: Assign Kennedy's Managing our common inheritance.

Hardin, Garrett, "The Tragedy of the Commons," *Science*, 163: 1243-1248.
url: http://www.sciencemag.org/sciext/sotp/pdfs/162-3859-1243.pdf
[Optional Readings: Extensions of "The Tragedy of the Commons," by Hardin at http://www.sciencemag.org/cgi/content/full/280/5364/682]

April 25: Understanding Evolution of Human-crafted Rules

Essential readings:

Dietz, Thomas, Elinor Ostrom, and Paul Stern. 2003. "The Struggle to Govern the Commons." *Science* 302(5652) (December 12): 1907-12. **Online:** http://www.sciencemag.org/cgi/content/full/302/5652/1907 **Supplemental Online Material at**: http://www.sciencemag.org/cgi/content/full/302/5652/1907/DC1

Ostrom, Elinor. 2005. *Understanding Institutional Diversity*, Princeton: Princeton University Press.

Chapter 1: Understanding the Diversity of Structured Human Interactions, p. 3-31.
Chapter 4: Animating Institutional Analysis, p. 99-133.

MIDTERM BREAK APRIL 28-30

WEEK SIX: ECOLOGY, ECONOMICS AND INSTITUTIONAL CHANGES

May 2: The Role of Human Values and Knowledge Systems

Essential readings:

Tim W. Clark, *The Policy Process: A Practical Guide for Natural Resource Professional,* Yale University Press, 2002.

Chapter 1: Professional Challenge, p. 1-16.
Chapter 2: A View of Individuals and Society, p. 17-31.
Chapter 3: Social Process - Mapping the Context, p. 32-55.

Hong, Lu, and Scott E. Page. 2004. "Groups of Diverse Problem Solvers Can Outperform Groups of High-Ability Problem Solvers." *PNAS* 101(46):16385-389. **Online:** http://www.pnas.org/cgi/content/full/101/46/16385

WEEK SEVEN: COLLAPSES AND SURVIVAL OF SOCIAL ECOLOGICAL SYSTEMS

May 7: Economic Values of Ecology and Institutions

Essential readings:

Mark Sagoff, *Price, Principle, and the Environment,* Cambridge University Press, 2004.

Chapter 1: Zukerman's Dilemma, p. 1-28.
Chapter 4: Values in Use and in Exchange or What Does Willingness to Pay Measure?
Chapter 6: On the Value of Wild Ecosystems, p. 126-153.

May 9: Why some social ecological systems collapse and some don't

Essential readings:

Lance H. Gunderson and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems,* Island Press, 2002, ISBN: 1-55963-857-5 (paperback)

Chapter 3: "Sustainability and Panarchies" by C. S. Holling, Lance H. Gunderson, and Gary d. Peterson, p. 63-102.

Chapter 8: "Dynamic Interaction of Societies and Ecosystems – Linking Theories from Ecology, Economy, and Sociology" by Marten Scheffer, Frances Westley, William A. Brock, and Milena Holmgren, p. 195-239.

Robert Costanza, Lisa Graumlich, Will Steffen, Carole Crumley, John Dearing, Kathy Hibbard, Rik Leemans, Charles Redman, and David Schimel, "Sustainability or Collapse: What can we learn from integrating the history of humans and the rest of nature," *Ambio,* 36(7): 522-527, November 2007.

WEEK EIGHT: ADAPTATION, VULNERABILITY, AND RESILIENCE

May 14: Empirical Evidences

Essential readings:

Weiss, H. and Bradley, R.S. 2001. 'What drives societal collapse?' *Science,* 291(5504):609–10.

Hodell, D.A., Curtis, J.H. and Brunner, M., 1995. 'Possible role of climate in the collapse of the Classic Maya civilization', *Nature*, 375:391–4.

Haug, G.H., Günther, D., Peterson, L.C., Sigman, D.M., Hughen, K.A. and Aeschlimann, B., 2003. 'Climate and the collapse of Maya civilization', *Science*, 299:1,731–5.

Will Steffen, Paul J. Crutzen and John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature? *Ambio*, 36(8): 614-621, December, 2007.

May 16: Adaptation and Resilience

Essential readings:

Carlson, Jean M., and John Doyle. 2002. "Complexity and Robustness." *Proceedings of the National Academy of Sciences* 9 (suppl. 1) (February 19): 2499–545.

Kates, Robert W., and Thomas M. Parris. 2003. "Long-Term Trends and a Sustainability Transition. *Proceedings of the National Academy of Sciences* 14 (July 8): 8062-8067.

Turner, B. L., et al., 2003. "A Framework for Vulnerability Analysis in Sustainability Science." *Proceedings of the National Academy of Sciences* 100(14) (July 8): 8074-8079.

May 21 – 23 Group Project Meetings and Writing sections

I will be in Southeast Korea from May 22-27 for academic conference and research meetings.

WEEK NINE: CROSSING BOUNDARIES AND BUILDING BRIDGES

May 28: Vulnerability and Shocks

Essential readings:

Brian Walker and David Salt, *Resilience Thinking: Sustaining Ecosystems and People in Chaining World*, Island Press, 2006, ISBN: 1-59726-093-2 (paperback)

Chapter 1: Living in a Complex World
Chapter 3: Crossing the Threshold
Chapter 4: In the Loop: Phases, Cycles, and Scales

May 30: Team paper presentations

May 31: Team paper presentations

NOTE: May 31 is reading day but final team presentations will be scheduled during class time.

Appendix A
Guideline for Review of Documentary Videos

Assignment

Student will select one documentary video out of three shown for the class discussion. Each of these videos deals with quantitative and qualitative arguments dimensions of complexity of social ecological systems. These arguments are weaved into motion pictures and narratives. The central task for students is to identify key theme of documentary in defining complexity of social ecological system. How does the documentary unpack the complexity of human society and ecological systems in the case of Mystery in Alaska? How does the documentary portray the relationship between social change and ecological changes in the case of Life after People? How does the documentary define ecosystem dynamics and complexity in the case of Queen of the Tree? You will review both qualitative and quantitative arguments made by producers using images and narratives.

Goals

As you will see in each documentary, the concept of complexity and dynamics are defined in each movie. In addition, the notion of livelihood system of both human and non-human systems plays a central thread in weaving the complexity. In so doing, the producers uses images and narrative qualitatively and quantitatively.

1. *to introduce students to quantitative critical thinking.*
2. *to learn how to present powerful narratives with quantitative evidences and images.*
3. *to prepare for the main assignment of this course (term paper) which requires critical understanding of quantitative data from multiple dimensions and applying quantitative evidences and critical thinking in writing persuasive narratives.*

Evaluation of Your Assignment

Your movie review will be evaluated by: (1) your identification and analysis of key quantitative and qualitative arguments made by producers using motion pictures and human expressions in words, gestures, and actions; (2) your identification and analysis of the central theme of the film and your analysis of how the key qualitative and quantitative arguments identified in step 1 frame the central theme of the documentary; (3) organization of review essay; (4) control of language and errors; (5) application of concepts and theories from assigned reading in analyzing the themes of the movie; and (7) your critical thinking,
It should be written between 4 and 6 double-spaced pages with Time News Roman 12-point font. If you need more pages, please do so as long as your essay justifies it but no more than 7 pages.

Due Date

To be self-assigned but the due time and date has to be no later than at 5:00p.m. on the 7th day after the movie is shown at the LIBE 344 as scheduled in the Syllabus.

Appendix B
Grading Rubric for Movie Review Essay

The following is my evaluation of your movie review. The categories are taken from my guidelines for this assignment:

Category	**Comments**
Identification of key themes of the movie.	- Do you clearly identify and discuss the main themes of the movie?
Organization, language and control of errors	- Do you organize your essay to be coherent and connected from point to point? Do you apply appropriate choice of language to increase precision of your ideas? Do you proof read and control errors?
Application of the concepts from readings and class discussions	- How well do you apply relevant concepts and theories from the readings?
Quantitative and Qualitative Review of the central theme(s) of the movie	- Do you identify quantitative arguments made by producers using images and narrative? How well are they successful? What will you suggest to improve their points?
Critical thinking and evaluation	- What is your critical interpretation of the themes? What do you learn from the movie? How does the movie link to theories we study in class?
TOTAL Points	

Appendix C
Understanding Three Approaches to Sustainability Sciences
POSC333 – Sustainability Science

This assignment is an alternative assignment to Livelihood System Analysis paper assignment stated in the syllabus. Students can pick one or the other.

Goal

The goals of this project are: (1) compare and contrast three modes of analysis that have emerged to address human-environment relations on a large scale ;(2) to explore the feasibility and desirability of endeavoring to meld these modes of analysis into a more integrated analytic framework; and (3) to familiarize with three main approaches that are currently driving force of the field of Sustainability Science.

Three modes of analysis and canonical texts

1. Earth System Science – ESS

   Steffen, Sanderson, Tyson, Jäger, Matson, Moore, Oldfield, Richardson, Schellnhuber, Turner, and Wasson, *Global Change and the Earth System: A Planet Under Pressure.* Berlin: Springer, 2004. Carleton Call Number: GE149 .G526 2004

   The Science Education Resource Center, Carleton College, offers the following definition: "Earth system science embraces chemistry, physics, biology, mathematics and applied sciences in transcending disciplinary boundaries to treat the Earth as an integrated system and seeks a deeper understanding of the physical, chemical, biological and human interactions that determine the past, current and future states of the Earth. Earth system science provides a physical basis for understanding the world in which we live and upon which humankind seeks to achieve sustainability."[4]

2. Sustainability Science – SS

   Board on Sustainable Development, *Our Common Journey: A Transition toward Sustainability.* Washington, DC: Natonal Academy Press, 1999
   [https://bridge.mnpals.net/vufind/Record/.b33891795]
   Kates, Clark et al., "Sustainability Science," *Science,* 292 (27 April 2001), 641-642
   Clark, "Research Systems for a Transition Toward Sustainability," in Steffen, Jäger, Carlson, and Bradshaw eds., *Challenges of a Changing Earth.* Berlin: Springer, 2002
   Clark, "Sustainability Science: A room of its own," *PNAS,* 104 (6 February 2007), 1737-1738

   Three academic journals:
   http://www.springer.com/environment/environmental+management/journal/11625
   http://www.polosustainability.com/ijsss
   http://sspp.proquest.com/archives/vol7iss2/TOC.html

3. Socio-ecological Systems – SES

   Gunderson and Holling eds., *Panarchy: Understanding Transformations in Human and Natural Systems.* Washington, DC: Island Press, 2002

Walker and Salt, *Resilience Thinking: Sustaining Ecosystems and People in a Changing World.* Washington, DC: Island Press, 2006
Elinor Ostrom, "A General Framework for Analyzing Sustainability of Social-Ecological Systems," *Science 24 July 2009: Vol. 325 no. 5939 pp. 419-422*
http://www.sciencemag.org/content/325/5939/419.abstract
PNAS Issues: http://www.pnas.org/content/by/year
Flagship journal: *Ecology and Society*, http://www.ecologyandsociety.org/

Processes

Students will write a paper interpreting and analyzing three approaches to understand and theorize human-environment interactions. A comparative analysis of three approaches is the central focus of this assignment. Based on the reading provided and assigned for the seminar, students will write 10 to 12 page. Your paper will be evaluated based on: (1) how well you identified each approach; (2) comparative analysis of each approach; and (3) your critical analysis of the strength and weakness of each approach.