

GEOL 1600: GLOBAL SUSTAINABILITY MANAGING THE EARTH'S RESOURCES COURSE SYLLABUS – FALL, 2015

Instructor Information

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Office hours: MWF 8:00-9:00 am

General Course Logistical Information

Credits: 4
USP 2003 G, S
Class meeting times: MWF 9:00-9:50 am
Class Location: EN 3114
Lab meeting times: sec. 10: Wednesday, 3:10-5:00 pm, ESB 1006
sec. 11: Monday 1:10-3:00 pm, ESB 1006
sec. 12: Thursday, 3:10-5:00 pm, ESB 1006
(no lab the first week of classes)

Attendance Policy:

- Lecture: Although attendance is strongly correlated with success in any class, lecture attendance is not mandatory and will not be monitored. Some topics not covered in the readings will be presented in lecture and there are graded lecture activities and worksheets that are part of the final course grade. All of these are sources for exam questions.
- Lab: Attendance is mandatory for the lab portion of the class and will be monitored. The lab syllabus, which you will receive the first week of lab, more fully describes how the lab will work, lab attendance policy, and make-up options for missed lab work.
- University sponsored absences are cleared through the Office of Student Life.

Text(s) and Readings: There is no required or assigned textbook. All readings are assigned based on material on the Web. This class involves weekly readings for both lecture and lab. Failure to do the readings will hinder your ability to perform successfully in lab and to grasp fully the topics discussed in lecture. In sum, doing the assigned readings will materially improve your chances of earning a good grade in this course.

Course Description

Uses biology, chemistry, physics and Earth science to examine Global Sustainability and how this worldview might guide our future management of Earth resources. Case studies in different international settings place questions of resource exploitation (discovery, extraction, processing, use, and disposal) and sustainability in a larger global context.

Course Objectives & Outcomes

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This course will introduce you to the basic scientific principles of the biological, Earth and physical (chemistry and physics) sciences. It will also explore the interrelationships between these traditional scientific disciplines. While emphasizing the content, application, methodology, and scientific inquiry of these disciplines, the course will also explore how the application of science to broader societal issues impacts our daily lives.

Specific Objectives of this course include:

1. Providing an introduction to the fundamental principles of the biological, Earth and physical sciences.
2. Examining how basic scientific concepts in these disciplines evolved.
3. Introducing students to the scientific approach as practiced in these disciplines.
4. Addressing the scope and limitations of the scientific approach.
5. Addressing how these disciplines influence and are influenced by contemporary society.
6. Showing how science, scientific reasoning and scientific processes are crucial for making informed, societal decisions.
7. Introducing the concept of sustainability and its general principles.
8. Examining the concept of grand challenges and demonstrating how humankind has become the dominant geologic agent on the planet.
9. Investigate the Energy-Water-Climate Nexus and its relevance to modern society and the sustainability movement.

Grading Policy

Your grade will be based on a total of 1375 points that are divided between lecture activities and worksheets, three lecture exams, a final exam, lecture and lab reading questionnaires, lab quizzes, and lab exercises. The large number of graded activities should ensure that if you do poorly on one graded task, e.g. an exam, your final grade need not be adversely impacted if you perform well on other tasks. The grading scheme for the course is summarized below:

activity	value	#	total points	% of lab grade
lecture reading questionnaires	10	14	140	10
lecture worksheets	15	10	150	11
lecture activity	10	1	10	0.01
lecture exams	100	3	300	22
lab (see breakdown below)	-	-	575	42
final exam	200	1	200	15
Total Points			1375	100

The most up to date summary of the grading scheme can be found on WyoCourses since the system tracks changes in assignments and assigned points automatically.

Each week there will be a weekly lecture reading questionnaire due every Monday. They will constitute 140 points of your final grade (10 %). Each questionnaire covers an assigned reading and consists of ten simple questions. The questionnaire is due by midnight on the due date. Questionnaires must be submitted via WyoCourses. They are graded automatically so pay attention to spelling. You will have two attempts to submit a questionnaire. The system will save the attempt with the highest score. After two attempts, you can no longer change your answers to the questionnaire although you can view your answers and the correct answers after the final due date.

Throughout the semester you will complete 15 lecture worksheets during class time that are worth 10 points each. The 150 points from these worksheets will comprise 11% of your

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final grade. Worksheets are done in class and are unannounced. They are not graded, rather you simply sign the attendance sheet for that day to get the points. If you miss a class when a lecture worksheet is completed, you can only make it up if you have a valid excuse for your absence. Lecture worksheets focus on topics we have covered in lecture and provide you an opportunity to apply your new knowledge while preparing for exams.

We will do one lecture activity during the semester. It will be worth a total of 10 points (1%). The activity is unannounced and you get the points for just being in class and doing the activity. If you miss class that day, you can only make up the lecture activity with a university excuse or valid, documented medical reason.

Three hundred points (22 %) will be from lecture exams. The exams will be on:

- Monday, October 5, 9:00 am, EN 3114
- Monday, November 2, 9:00 am, EN 3114
- Friday, December 4, 9:00 am, EN 3114

Each exam will be worth 100 points. They will cover the material presented in lecture and any assigned readings, but not the labs. Past exams and their keys are posted on WyoCourses. Use them when you study for exams. You must obtain prior permission to take an exam at any time other than during the scheduled class session. If you skip an exam, you fail it with a zero. During exams, please turn off and put away all electronic devices. Electronic dictionaries are not allowed, however international students may ask for clarification of English terms during an exam.

There will also be a 200-point final exam (15 %) on Monday, December 14 from 8:00 to 10:00 am in EN 3114. This exam will be comprehensive and have approximately twice the number of questions as one of the hour long, lecture exams. At least 50 % of the points on the final exam will be from questions taken from the three lecture exams. During the final exam, please turn off and put away all electronic devices. Electronic dictionaries are not allowed, however international students may ask for clarification of English terms during the final exam. The time of the final exam is established by the Office of the Registrar (http://www.uwyo.edu/registrar/class_schedules/fall2015/fa15finals.pdf). It may not be taken early. Students who have two exams at the same time or more than two exams in one day and wish to ask for an exception must complete the Final Exam Conflict form available from the Office of the Registrar. The online form is available at http://www.uwyo.edu/registrar/students/forms_and_petitions.html. *The form must be submitted no later than two weeks prior to the end of finals week.* Requests submitted after this date are left to the discretion of the instructor whether or not they will be accommodated. *If you cannot make the scheduled time of the final exam, you need to drop this course immediately.*

The lab will make up the final 500 points (39 %) of the course grade. The breakdown for the various lab activities and their points are:

activity	value	#	total points	% of lab grade
lab reading questionnaires	10	13	130	23
lab exercises	25	13	325	57
lab quizzes	10	12	120	21
Total Points			575	100

All students must participate in lab and complete the assigned work. Unlike for lecture, attendance of lab is mandatory. You must receive a passing lab grade to pass the course. The lab syllabus, which you will receive the first week of lab, more fully describes how the lab will work. Missed work can only be made up if you have an official University excuse for missing lab or have obtained permission from your lab TA before you miss lab. Any late

Deleted: 4-Sep-15

work must be made up within one week of its due date (see lab syllabus for additional details). There will be no lab final.

Each week there will be a weekly lab quiz that covers the material from the previous week's lab. They will constitute 120 points of your lab final grade (21 %). These quizzes are taken online in the lab classroom. The quizzes will be available at the beginning of the official lab class period and until 10 minutes after class starts. Thus, if you have a 1:10 pm lab, you can take the quiz on one of the lab computers between 1:10 and 1:20 pm. If you come to lab late and miss the quiz cut-off time, you fail the quiz.

Each week there will be a weekly lab reading questionnaire due the day before your lab session. They will constitute 120 points of your lab final grade (24 %). Each questionnaire covers an assigned reading and consists of ten short-answer questions. The questionnaire is due by midnight on the due date. Questionnaires must be submitted via WyoCourses. They are graded automatically so pay attention to spelling. You will have two attempts to submit a questionnaire. The system will save the attempt with the highest score. After two attempts, you can no longer change your answers to the questionnaire although you can view your answers and the correct answers after the final due date.

There will be no grading curve for this course. (Every year I have taught this course the final grade distribution worked out such that I would not have curved the grades even if I did not have a no-curve policy.) Final grades will be assigned according to the following scale:

Grade	Percentage cut-off	Point cut-off
A+	≥97	≥1,334
A	≥93	≥1,279
A-	≥90	≥1,238
B+	≥87	≥1,196
B	≥83	≥1,141
B-	≥80	≥1,100
C+	≥77	≥1,059
C	≥73	≥1,004
C-	≥70	≥963
D	≥60	≥825
F	<60	<825

A fixed grading scheme emphasizes that you are not competing with your peers for a grade. It also means your grade in the course is based on the quality of your work, not on how well or poorly your peers do in the course. If all students in the course earn an A, I will be very pleased. It would indicate you all worked hard and mastered the subject matter. One way of achieving this is by working with your peers to understand the topics presented in lecture and lab.

Course Details

Organization

This is a lecture-lab course. Lecture and lecture worksheets will familiarize you with the Earth resources necessary to support a modern industrial society. They will examine where these resources occur, how they are extracted and processed, how they are used, and the types and scales of waste streams produced by these activities. Lectures will also introduce you to several recently developed concepts, e.g. sustainability, grand challenges, common pool resources, and public goods among others, that provide the framework within which to examine how humanity can extract and utilize Earth resources in the least environmentally

Deleted: 4-Sep-15

disruptive manner while promoting an equitable distribution of positive *and* negative outcomes. The critical thinking skills, quantitative tools, and visualization competences necessary for addressing the complex issues of sustainability while solving grand challenges will also be introduced. Through classroom and lab application you will learn to use them to answer the many objective and normative questions that revolve around sustainability implementation, grand challenge resolution and Earth resource management. Lecture will also demonstrate how just, equitable, effective, and sustainable resource solutions require the incorporation of multiple stakeholders as well as perspectives, e.g. scientific, technical, engineering, social, political, economic, etc.

To provide real world meaning to these concepts, lab will investigate specific resource issues from a sustainability perspective. For example, some lab sessions will address various issues of energy and water. Energy labs will look at finding coal and assessing the environmental impact of coal combustion on carbon dioxide emissions and investigate oil and natural gas exploration and the economics of producing these hydrocarbons from conventional geologic reservoirs. Water labs will address groundwater contamination from industrial activities as well as arsenic pollution in groundwater in Bangladesh.

Course Objective & Social Relevance

The human population is presently well over seven billion with projections suggesting it will be between 9 and 15 billion by 2050. Each one of these individuals must be fed, clothed, and sheltered. These tasks all take varying amounts of Earth resources. Thus, building materials, chemical minerals, and industrial minerals must be mined and processed; vast quantities of metallic ores mined, processed, and their metals separated from waste; exploration and drilling are necessary to find and produce oil; wind and water must be harnessed; and solar energy captured. All of these activities impact human and natural systems in both positive and negative ways. Unfortunately, these activities produce large streams of solid, liquid, and gaseous waste that must be collected, treated, and disposed of in benign ways that do not adversely impact human health or safety nor compromise local, regional, and global ecosystems. Accomplishing this variety of tasks requires engaging a wide range of stakeholders at all stages in the life cycle of an Earth resource commodity. Unlike in many places in the world, you, as a citizen of a modern, industrial democracy, have a voice in the political processes that determines how your energy, water, and Earth resources are produced, processed, used, and associated wastes disposed. The policies, laws, and regulations under which these activities are conducted will directly impact you, your children and even your great, great grandchildren.

This course seeks to introduce you to the concepts and tools, which will help you make informed decisions about resource issues. Armed with these tools and concepts, you can play a constructive and beneficial role in future resource discussions. This course will introduce the central theme of sustainability along with the concept of a grand challenge both of which are central to the exploitation and use of Earth resources. To provide you with the tool chest necessary to address these issues, you will learn about the special characteristics of resource issues that make them exceedingly different to solve, i.e. they are classified as wicked and superwicked problems. Because of their central role in human survival, the class will focus on two fundamental resources, i.e. water and energy. In addition, to documenting how these resources are intertwined, the course will also explore the connection between these two grand challenges as well as their role in climate change. Thus, you will explore the fundamental energy-water-climate nexus. The planetary boundary concept will be presented to help you place the magnitude of the energy-water challenge in global perspective. Upon completing the course, you will be able to:

- identify data/information needed to make an informed decision about a particular resource issue, sustainability, and grand challenge issues;
- distinguish between normative and objective questions and statements;
- explain the concept of sustainability and its three foundational pillars;

Deleted: 4-Sep-15

- describe the characteristics of the grand challenges humanity faces and list some of the most significant and pressing;
- understand planetary boundaries and appreciate how human activity has reached the scale of disrupting global ecosystems;
- describe the Energy-Water-Climate (EWC) Nexus and recognize the connections and interdependencies between these three grand challenges;
- understand the nature of wicked and superwicked problems and how these relate to sustainability and grand challenges; and
- appreciate the many factors that make resolution of wicked and superwicked problems so elusive.

Literacies

To understand the content of a scientific discipline and apply it successfully to a range of societal issues and problems, it is necessary to master a number of different skills, i.e. literacies, that are separate from content knowledge. These literacies fall into three basic groups: fundamental, technical, and citizenship. The fundamental literacies allow you to manipulate the data and information of a scientific discipline. Although you should have used some of the literacies previously in your educational career, you may have not had much practice with them recently. The fundamental literacies include the:

- ability to *read* a table and *interpret* a graph or chart;
- facility to *make* qualitative assessments;
- capacity to *estimate* the magnitude of simple quantitative calculations; and
- aptitude to *perform* simple quantitative calculations correctly.

For many sciences like geology, which describes the formation and setting of many Earth and mineral resources, an additional set of literacies are necessary. These are the technical literacies, which allow you to understand and appreciate the scale of geological change and structures and how they are impacted by resource activities, singularly and cumulatively. Because of their more advanced nature, you may have had limited practice with some of these technical literacies. Indeed, some may be completely new to you. The geosciences technical literacies consist of the:

- skill to *read and interpret* different types of maps;
- ability to *visualize* in three dimensions; and
- capacity to *conceptualize* changes through time.

This course will provide you with practice mastering all of two literacies as you learn the scientific and STEM basics of global sustainability.

Lecture

Although it should go without saying, please do not engage in conversations with your neighbor while I or one of your peers is addressing the class. In addition, if one of your classmates has been recognized and is speaking, please be courteous and do not interrupt them or talk over them. Such behavior is disrespectful not only to the speaker but to your classmates as well. Extraneous conversations and comments are distracting to your neighbors, disruptive to the class as a whole, and prevent others from hearing what the speaker has to say. Anyone repeatedly talking out of turn during lecture will be asked to leave immediately. When entering class, please silence your cell phone so it will not distract people if it rings. While you are free to use electronic devices in class, they must be used for class purposes only, e.g. searching something on the topic being discussed, viewing the WyoCourse web site, browsing the current class presentation, etc. Checking social media is not considered a class activity. I have sat in on classes where students do this and have observed it distracting students sitting around the individual surfing.

The tentative lecture schedule for Fall, 2015 is shown in the table below.

	week of...	topics
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0	31-Aug-15	The Grand Challenges & the EWC Nexus
1	7-Sep-15	Planetary Boundaries
2	14-Sep-15	The Sciences: Basic Concepts and Principles
3	21-Sep-15	Energy: Intro, ES ² , Infrastructure
4	28-Sep-15	Energy: Electricity & Transportation
5	5-Oct-15	Energy: Fossil Fuels: Coal & Petroleum
6	12-Oct-15	Energy: Fossil Fuels: Unconventionals
7	19-Oct-15	Energy: Nuclear Power
8	26-Oct-15	Energy: Renewables: Solar & Wind
9	2-Nov-15	Water: A Critical Resource
10	9-Nov-15	Water: Chemistry & Physics
11	16-Nov-15	Water: Geology: Surface & Groundwater
12	23-Nov-15	Water: Hydroelectric Power
13	30-Nov-15	Water: Pollution and Law
14	7-Dec-15	Water: Virtual Water Trade

Lab

The table below documents the tentative lab schedule for Fall, 2015.

	week of...	topics
0	31-Aug-15	no lab
1	7-Sep-15	Population: The Demand Behind Resource Consumption
2	14-Sep-15	Maps: An Exploration and Planning Tool
3	21-Sep-15	Geologic Maps: Finding and Extracting Resources
4	28-Sep-15	Visualizing Earth: Thinking in Three Dimensions
5	5-Oct-15	Energy: The Forms of Energy
6	12-Oct-15	Energy: Fossil Fuels: Coal Exploration & Mining
7	19-Oct-15	Energy: Coal and the Costs of Electricity Generation
8	26-Oct-15	Energy: Fossil Fuels: Finding Oil
9	2-Nov-15	Energy: The Views of Oil Importers and Exporters
10	9-Nov-15	Water: Its Physical & Chemical Behavior
11	16-Nov-15	Water: Groundwater – Tracking Pollution Plumes
12	23-Nov-15	Water in Bangladesh: Tube Wells and Arsenic – I. Constructing a Groundwater Model
13	30-Nov-15	Water in Bangladesh: Tube Wells and Arsenic – II. Assessing Water Quality
14	7-Dec-15	Climate: Using Wedges to Mitigate CO ₂ Emissions

General University Policies/Regulations

Class Effort

According to the UW catalog "Each credit hour unit requires an average of three hours of student effort per week". Since this is a 4 credit course, you should expect to work a minimum of twelve hours a week outside of class meetings. To get a good grade in the class, expect to work more than this. Also prepare for exams well in advance. Don't start studying the night before and expect to earn a good grade on the exam.

Final Examination Policy (UW Regulation 6-403)

- The Registrar is authorized to schedule final examinations. With only the exceptions specifically designated below, exams will be given at the times thus designated and no

Deleted: 4-Sep-15

other times. The examination schedule shall be published at least one month before the first day of final examinations.

- No student shall be required to take more than two final examinations in any one day. Along with the specific final examination schedule, the Registrar shall indicate a system of priorities which will determine which course is expected to offer an examination at a different time for a student who is scheduled for more than two final examinations in one day or more than one at the same hour.
- To avoid excessive pressure on students during the week before final examinations, no examination or graded exercise should be given in the last week of classes unless it is essential for the effective functioning of the course. If an examination or graded exercise in the last week of classes is deemed essential, the instructor shall notify the students of it in a class syllabus distributed at the beginning of the course.
- Instructors are not obligated to give final examinations ahead of schedule to those students who, for legitimate reasons connected with official University activities, cannot take the final examination at the scheduled time. In such cases, students are entitled to receive a grade of "X", subject to the usual procedures and conditions of the grade of "X".
- More information: <http://www.uwyo.edu/generalcounsel/files/docs/uw-reg-6-403.pdf>.

Student Absence Policy (UW Regulation 6-713)

- **Class Attendance:** Each student shall attend the lectures, recitations, and laboratories and participate in field work deemed necessary to fulfill adequately the academic requirements of each class. Each instructor, at the beginning of every semester, shall stipulate the attendance policy necessary for satisfactory completion of the course.
- **Authorized Absences:** For participation in a University-sponsored activity or for unusual circumstances, such as a personal hardship, an authorized absence may be issued to the student by the Dean of Student's or the Dean's authorized representative. If a student has been hospitalized, or if the student has been directed by the Student Health Service or the student's private physician to stay at the student's place of residence because of illness, the Health Service medical staff or the student's private physician may issue a statement to the student giving the dates of the student's confinement.
- **Recognition of Authorized Absences:** All instructors shall permit students who have official authorized absences to make up work without penalty in the classes missed. An authorized absence, however, merely gives the individual who missed the class an opportunity to make up the work and in no way excuses the student from the work required.
- More information: <http://www.uwyo.edu/generalcounsel/files/docs/uw-reg-6-713.pdf>.

Academic Honesty (UW Regulation 6-802)

- All members of the University community are responsible for upholding the values of academic integrity. The faculty considers academic integrity a matter of common concern, not merely a private issue between instructor and student. Honesty in all academic endeavors is a component of academic integrity that is vital to the educational functions of the University. Whatever form academic dishonesty may take, the faculty considers it as establishing a student's failure to demonstrate the acquisition of knowledge and the failure to apply it to an academic endeavor. It is a student's responsibility to learn the standards of conduct for the performance of academic endeavors; it is an instructor or faculty member's responsibility to make reasonable effort to make known the standards of conduct for the performance of academic endeavors. Through an atmosphere of mutual respect we enhance the value of education and maintain high standards of academic excellence. Failure on the part of the student to observe and maintain standards of academic honesty, as hereafter defined or

Deleted: 4-Sep-15

made known by an instructor responsible for a course or other academic endeavor, requires corrective action as hereafter authorized.

- **Academic Dishonesty:** An action attempted or performed that misrepresents one's involvement in an academic endeavor in any way, or assists another student in misrepresenting his or her involvement in an academic endeavor. Examples of academic dishonesty include, but are not limited to:
 - *Plagiarism:* presenting the work (i.e., ideas, data, creations) of another, wholly or in part, as one's own work without customary and proper acknowledgement of sources and extent of use, unless authorized by the instructor.
 - *Cheating:* using information, study aids, notes, materials, devices, or collaboration not explicitly approved by the instructor. For example: doing a class assignment for someone else or allowing someone to copy one's assignment; copying from, or assisting, another student during an examination; or stealing, or otherwise improperly obtaining, copies of an examination before or after its administration.
 - *Fraud:* altering or inventing data, research, or citations for an academic endeavor; fabricating, forging or otherwise misrepresenting to an instructor or an institution one's past or current academic or professional activities; impersonating someone or allowing oneself to be impersonated for an examination or other academic endeavor; using a ghost writer, commercial or otherwise, for any type of assignment.
 - *Violation of Standards:* violations against ethical and professional standards required by individual University programs, academic courses, and clinical programs that may result in qualification for entry into a profession that maintains standards of conduct.
 - *Multiple Submissions:* submitting, wholly or in part, the same academic endeavor to earn credit in two or more courses without explicit approval by all concerned instructors.
 - *Interference or Obstruction:* interfering with academic efforts of other students to gain unfair advantage for personal academic advancement. Interference may include but is not limited to, sabotage, harassment, tampering, bribery, or intimidation of another student.
 - *Complicity:* assisting another person in any act of academic dishonesty as defined above.
- **Academic Endeavor:** Any student activity undertaken to earn University credit or meet some other University program requirement. Examples of academic endeavors include, but are not limited to:
 - Course assignments (written and/or oral, projects, research, exhibitions of work)
 - Exams (written and/or oral, quizzes)
 - Clinical assignments (internships, rotations, practical)
 - Presentations (on and off campus)
 - Publications
 - Independent study coursework
 - Plan B papers or projects, theses, dissertations
 - Student media associated with academic credit
- More information: <http://www.uwyo.edu/generalcounsel/files/docs/uw-reg-6-802.pdf>.

Disability Statement

If you have a physical, learning, sensory or psychological disability and require accommodations, please let me know as soon as possible. You will need to register with, and provide documentation of your disability to, University Disability Support Services (UDSS) in SEO, room 330 Knight Hall, 766-6189, TTY: 766-3073.

Deleted: 4-Sep-15

Other University regulations can be found at: <http://www.uwyo.edu/generalcounsel/new-regulatory-structure/index.html>.

Disclaimer

I reserve the right to make changes to any aspect of this syllabus as the course proceeds. If necessary, these changes will be announced in class. Substantive changes made to the syllabus shall be communicated to you verbally in class and in writing via WyoCourses.

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