Geological Foundations of Environmental Science

Instructor Information

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Our Elegant Universe

During the last three decades of his life, Albert Einstein sought relentlessly for a single, all-encompassing, solitary theory that would describe nature's forces. He was driven by a passionate belief that by understanding the universe at its core, we could also reveal its truest wonder, elegance, and sheer beauty. He never succeeded. Knowledge is always growing and changing. Facts are transient, Justice is subjective, and the Truth is merely elusive.

Course Description

Our planet was "created" approximately 4.57 Gigayears ago. Our planet is one of over 2000 known planets, yet how much do we know of our abode? Much and not so much. This course will seek to uncover a few facts, elicit many questions, and provide an intuitive and quantitative awareness for our Earth. Specifically, the course is designed as an introductory subject that will focus on the principals and concepts of Earth's resources, geologic systems, plate tectonics, hydrologic systems and the basic forces that serve as architects of the planet's surface.

There are two required field trips.

Prerequisites:	420.301 - Quantitative Methods 420.302 - Chemistry of Natural Processes

Programmatic Learning Goals

Our overall programmatic goals at ESP have several objectives and we will hit upon all of these as we read, discuss and proceed through course. Among our learning goals, we want to identify root and structural causes and the systemic nature of environmental problems (such as nuclear disasters), critical interpretation of environmental information (e.g. radiometric data dating geologic processes), synthesizing scientific studies (e.g. the impacts of Love Canal on Superfund legislation), integrating basic principles derived from your core courses (e.g. oceanography) and finally we want to frame our science discussions around sound policy decisions (e.g. wilderness preservation in geoparks).

The specific program learning goals are:

- Understand environmental policy making processes, institutions, and organizations to be able to identify root and structural causes and the systemic nature of environmental problems.
- Research and recommend methods for collection, analysis, presentation and critical interpretation of environmental information using appropriate statistical and quantitative tools.
- Develop competency in evaluating and synthesizing scientific studies to guide environmental decision making, policy making, and advocacy. Utilize the practical and theoretical components of environmental science and policy to develop local and global environmental strategies.
- Describe and analyze environmental problems by applying or integrating basic principles derived from natural and social science, legal, and economic frameworks. Additionally, to conceptualize, develop and devise bridges between the realms of policy and science on critical environmental issues.
- Evaluate effective strategies, technologies, and methods for sustainable management of environmental systems at and for the remediation or restoration of degraded environments in conjunction with evidence-based, science-informed environmental policy analysis.

Course Goals & Learning Objectives

By the end of this course, you will be able to:

- Develop an integrated and interdisciplinary understanding of the nature of science and scientific reasoning.
- Use an Earth systems science approach to examine solid-Earth processes (the lithosphere) and how these processes are related to processes in the atmosphere, hydrosphere, and biosphere.
- Examine technological, societal, and environmental issues related to natural resources and natural hazards.
- Develop and use critical thinking skills to investigate the nature of scientific inquiry.
- Develop lab- and field-based skills related to geologic observation and description.
- Understand core areas of geology and environmental geology, and interpret a wide range of earth processes on different temporal and spatial scales.
- Use the concept of plate tectonics to explain the formation of different rock types and the distribution of geologic hazards such as earthquakes and volcanoes.
- Describe human activities that exacerbate hazardous geologic conditions by increasing the frequency and/or magnitude of a geologic hazard.
- Evaluate hazard mitigation strategies, providing examples of successes and failures.
- Analyze the concomitant problems associated with resource extraction and waste disposal, and select appropriate mitigation strategies.
- Identify the relationships between human population growth, economic development, and resource consumption, and appraise strategies for ensuring

future resource availability.
- Demonstrate competence in collecting scientific data, including field observation and field and analytical measurements.

Course Materials

Textbook

Essentials of Geology - 2016. (5th edition). W. W. Norton & Company. ISBN 978-0-393-26339-8. The previous edition is acceptable.

I will draw most of the lecture material from this text. For those desiring a more thorough review of basic geological principles, this will be a valuable resource.

Other Readings

All other readings will be posted on the online classroom with support from JHU reserves.

Other equipment / software/ websites / online resources

A number of supporting exercises and questions will be assigned or available to study in coordination with our class textbook. The various files and assignments will be posted to Bb. You will need access to a spreadsheet such as MS Excel, Apple Numbers or Google Docs will facilitate basic quantitative analysis.

Section 3
Course Overview and Goals

The principle role of this course is to provide the basic geological background needed to pursue more detailed study of geological topics covered in the program electives, while giving you a view of the breadth and importance of earth science as a foundation for environmental science.

We will depend heavily on a textbook, supplemental readings, lectures and two field trips. Classes will include lectures and discussions as well as occasional "lab" activities. It is impossible, of course, to cover all interesting and pertinent aspects of geology in a single course. I have selected specific topics based on their general importance to learning more geology in the electives; direct significance to environmental issues; or illustration of general scientific principles and processes that are exploited as resources or provide understanding of environmental degradation. This means an intensive study of plate tectonics in the first week of the course followed by detailed investigations of Earth materials (minerals and rocks) for the next few weeks of the course. The middle of the course will be dominated by study of the nature and behavior of radioactivity and structures of the earth (with an introduction to stress in the earth and its relationship to folding and faulting). Throughout the course I will try to connect the more purely geologic topics to day-to-day resource use or formation. Your input during this process will be critical to bridging that gap... when you see connections, please make an effort to participate.

Lectures will focus on developing the geologic and physical background. Insofar as we can't cover all material in class, I will focus lectures on summarizing some subjects and examining specific examples of others. It is incumbent on you to use your text to fill out your specific knowledge of individual topics. The textbook is actually an excellent introductory book designed for a basic undergraduate course.

There will be in-class discussion and a few online discussions. The topics for the discussions will be announced in class and often revolve around assigned reading that goes beyond the text. Everyone is expected to participate. The online discussions are particularly good for more detailed and nuanced examination.

The supplemental readings, field trips and lectures will go beyond that undergrad level to cover things at a graduate level. We'll have detailed in-class discussions centered on pre-assigned reading or topical research. These discussions are not meant to be question and answer periods, but rather real discussions of the underlying assumptions, techniques, validity and implications of the papers. We may also use online discussions to allow more detailed coverage than possible in the limited class time.

Field Trips

There are two field trips. These trips are mandatory and critical to getting a big understanding of geology in a short space of time. You will probably learn more basic geology on these trips than in all the lectures combined. If you have a conflict with the trips please talk to me as soon as possible—there is no way to make up a trip and the replacement assignment (a 10-page research paper) is onerous for all involved. Past course evaluations make it clear that students find the fieldtrips the best way to understand the varied and numerous new geologic concepts and terms they encounter in the readings and lectures and, not coincidentally, trip attendance correlates strongly with exam performance. The first trip will center on a walking tour of sites where masonry was employed on or near the National Mall in Washington, D.C. It begins with an overview of the geological setting of the city and development of the Mall. Each federal monument or building on the tour will be briefly described, followed by information about its exterior stonework. The second trip will be along Skyline Drive to examine the central Appalachians. The central Appalachians form a classic orogen whose structural architecture developed during episodes of contractional, extensional, and transpressional deformation from the Proterozoic to the Mesozoic.
This field trip examines an array of rocks deformed via both ductile and brittle processes from the deep crust to the near-surface environment, and from the Mesoproterozoic to the present day.

The dates are on the calendar portion of this syllabus; please note them in your personal calendars.

Course Topics, Activities and Schedule

The following is a tentative Schedule of Topics and the associated reading from the text. Topics may be modified by the instructor, though advanced notice of no less than two days will be conveyed via the online classroom.

CLASS DATE	LECTURE SUBJECT	LAB/HW/Bb TOPICS	REFERENCE FROM TEXT
11 Sep	Introduction and Formation of the Universe, Solar System, Sun, Earth and Moon	Activity 1: Graphing Solar Abundances	Chapter 1
18 Sep	Atoms, Elements and Compounds and the Mineral Kingdom	Activity 2: Minerals	Chapter 3
25 Sep	Rock Cycle and Igneous Processes Melting and Volcanic Processes	Activity 3: Geothermal Gradients; QAPF Diagrams	Chapter 4 & 5
2 Oct	Weathering, Erosion and Soil, Sedimentary Rocks and Stratigraphy	Discuss The Gravel Pages	Interlude B, Chapter 6 and Reading under Lesson

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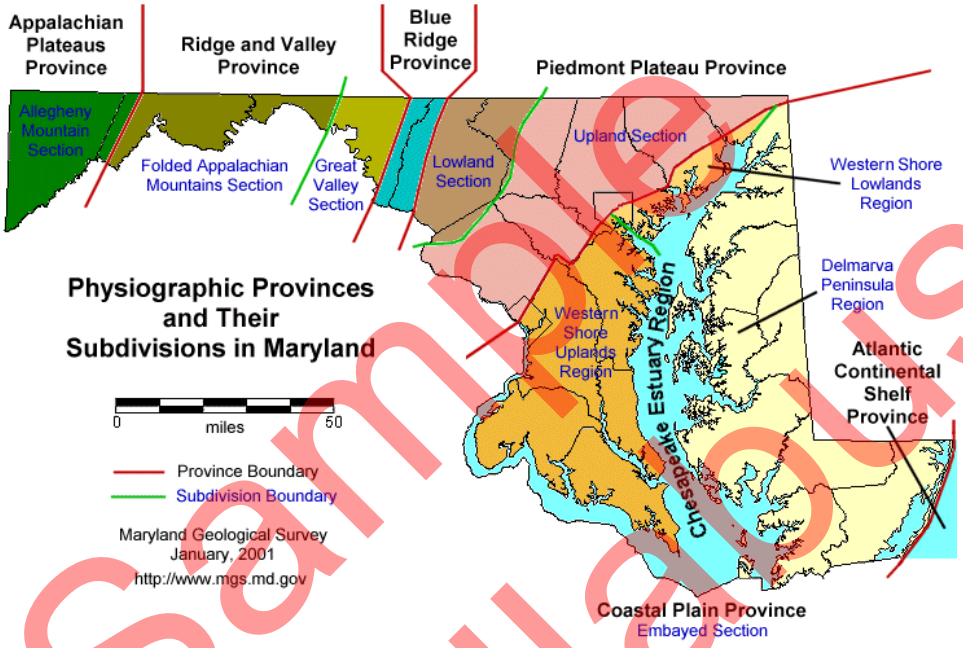
9 Oct	Mining Resources	Activity 4: Igneous Rocks; Binary Phase Diagram Or Mining Resources	Chapter 12 (Sections 12.6-12.15
16, 23 Oct	**National Mall Field Trip** & Geologic Time	Activity 5: Superposition and Activity 5: Geochronology	Chapter 10
30 Oct	Examination I		
6 Nov	Metamorphism and Deformation Mountain Building I – Faults/Folds	Activity 6: Rocks and Phase Diagams	Chapter 7
13 Nov	Earthquakes and Seismicity	Activity 7 – Sedimentary Rocks and Earthquake Activity	Interlude D and Chapter 8
27 Nov	Continental Drift and Tectonics I Plate Tectonics II and Global Tectonics		Chapter 2 and 9
4 Dec	Groundwater Pollution	Activity 8 - Contaminant Transport Activity	Chapter 16
11 Dec	Climate Change and Paleoecology		Chapter 19
18 Dec	Final Exam		Cumulative
16 Oct	**Field Trip 1 – National Mall**		
17 Nov	**Field Trip 2 – Skyline Drive**		



Grading

Your cumulative average will be based on the following weighted averages:

Category	Percentage Weights
Combined Classroom and Homework Assignments	35%
Examination 1	25%
Discussions	15%
Final Exam	25%

*Late work (any assignment turned in after an assigned due date) will receive zero credit and extra credit is not used in this course.

**Field Trips are considered part of the combined classwork and homework category.

Assignment Guidelines

How should assignments be submitted?

The weekly directions will indicate where assignments where and how assignments will be submitted (e.g. in assignment tool within the Lessons folder on Bb or by hand at the beginning of the subsequent class meeting). If submitting documents to an assignment or forum, please specify the assignment name in the discussion thread and/or the document title. When creating files, include your name and the name of the assignment in the file title. Also, please be sure to only include one period in file names. The period should be between the file name and the extension. For example: jburgess_assignment1.doc

What is the policy for late assignments?

You are expected to contact your instructor in advance if you think you cannot meet an assignment deadline. However, if an assignment is late and prior arrangements have not been made with the instructor, the assignment score will be zero.

Participation

What are the participation requirements?

There will be in-class discussion and a few online discussions. The topics for the discussions will be announced in class and often revolve around assigned reading that goes beyond the text. Everyone is expected to participate. Assignments given out in class, to be completed during class, cannot be made up if absent. The online discussions are particularly good for more detailed and nuanced examination. For

online discussions, I expect students to make at least two posts and one comment/reply per week. In general, people will participate more than that. Those are the minimums acceptable to pass that week's participation. It is not acceptable to "make up" missed participation by posting more in another week. The length and quality of posts also counts. The basic goal is to be a thoughtful and active member of the class. It is usually best to not think in terms of quantity of posts. Quality is the goal. It also doesn't help to repeat what others have said. If you think the topic is exhausted, introduce a new reference or direction for the thread. Participation will be graded for each discussion and is on a 5 point scale. Posting less than twice gets 0. Just posting twice gets a 2. The quality of the posts increases the grade. Respond to the topic or to what others have said. Find pertinent new information and introduce it to the discussion.

Network Etiquette (i.e. "Netiquette")

In this course, online discussion will be primarily take place in our online discussion board. In all textual online communication it is important to follow proper rules of netiquette.

What is netiquette? Simply stated, it's network etiquette -- that is, the etiquette of cyberspace. And "etiquette" means the social and cultural norms of communicating with others in a proper and respectful way. In other words, netiquette is a set of rules for behaving and interacting properly online.

The Netiquette "Core Rules" linked below are a set of general guidelines for cyberspace behavior. They probably won't cover all situations, but they should give you some basic principles to use in communicating online.

For Netiquette Core Rules visit The Core Rules of Netiquette web page.

Contacting the Instructor

The instructor for this course is Professor *J.L. Burgess (jerry.burgess@jhu.edu).* Feel free to contact me with comments, questions, and concerns. You will receive a response within 48 hours.

All email messages will be sent to you via your JHU email account, so you should be in the habit of checking that account every day or you should ensure that your JHU email account forwards messages to another account of your choice.)

Professionalism is expected throughout this course whether in the online

classroom or email. Your responses to questions, interaction/communications/emails with classmates or me should be professional in manner. This includes “netiquette” (electronic etiquette) such as using salutations (not “Hey!”) when you send an email, signing your emails, and responding to emails in a timely fashion.

University Policies

General

This course adheres to all University policies described in the academic catalog. A few to pay close attention to are noted below.

Students with Disabilities

Johns Hopkins University is committed to providing reasonable and appropriate accommodations to students with disabilities. Students with documented disabilities should contact the coordinator listed on the Disability Accommodations page. Further information and a link to the Student Request for Accommodation form can also be found on the Disability Accommodations page.

Ethics & Plagiarism

JHU Ethics Statement: The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor.

Read and adhere to JHU's Notice on Plagiarism.

Dropping the Course

You are responsible for understanding the university's policies and procedures regarding withdrawing from courses found in the current catalog. You should be aware of the current deadlines according to the Academic Calendar.