

ENRP 6101: Environmental Sciences I: Physical Sciences
Fall 2016

Time and Location	Wednesdays, 6:10 – 8:40 pm; PHIL 108
Instructor	Dr. Velmurugan “Vel” Subramanian, PE, BCEE Phone: 918 504 4152 Email: svel65@hotmail.com; vels@gwu.edu
Office Hours	By Appointment
Course Materials	Living in the Environment: Concepts, Connections, and Solutions by Miller/Spoolman, 16 th Edition Environmental Science: Earth as Living Planet by Botkin and Keller, 8 th Edition The Earth System by Kump, Kasting and Crane 3 rd Edition
Course Catalog Description	This course explores basic physical sciences crucial to environmental issues, including chemistry, geology, hydrology, climate science, and cross-media interactions; land, air, and water pollution, climate change, production and consumption of energy, sea level rise, and anthropogenic changes in the cryosphere. Emphasis is placed on students’ gaining a broad and yet significantly deep scientific knowledge to understand the scope and extent of human-environment interactions.
Learning Outcomes	At the completion of this course, students are expected to be able: <ol style="list-style-type: none">1. To become acquainted with the primary scientific disciplines of environmental sciences (i.e. atmospheric science, geoscience, and hydrosience) and understand how principles in these disciplines collectively govern the natural behavior of earth environment.2. To understand the complexity of environmental problems by learning the multiplicity of causes and consequences of major environmental issues we are facing.3. To be able define and explain the basic issues concerning the ability of human community to interact in a sustainable manner with the environment.4. To understand the importance of ‘system approach’ in environmental science and gain skill in applying the method to real environmental issues5. To be able to evaluate scientific information and arrive at defensible strategies as to their validity and applicability to improving environment qualities in an economic fashion.

Grading	Homework	25%
	Exam 1	22.5%
	Exam 2	22.5%
	Current environmental issues	5%
	Research Paper/Presentation	20%
	In-Class Problems/Activities	5%

A > 90%; B = 80% – 89%; C = 70% - 79%; D =60% - 69%; F = <60%

Homework/Research Paper Homework and other assignments are due at start of class on specified date. Hard copies shall be turned in. Late homework/projects will not be accepted. If you know you will miss a class, it is your responsibility to hand in any assignments in advance.

There will be one major research assignment during the course of the term. This assignment will be carried out with a partner and will require a written report and a presentation. A detailed description of this assignment and the requirements/expectations will be discussed during the class when it is handed out

Current Environmental Issues Each student is required to make a 5 minute presentation of any environmental issue of importance. Every week there will be one presentation and students will have to sign up for the date in advance.

Readings Assigned readings should be completed prior to the day of class when topics are discussed. Readings will be either from the text or from handouts.

Academic Integrity The highest standards of academic honesty is expected in the class. Cheating and plagiarism in any of their forms are unacceptable. All home works are to be individual work. The University Code of Academic Integrity can be found at <http://www.gwu.edu/~ntegrity/code.html>.

Laptop/Cell Phone Policy Use of computers is not allowed for web surfing, e-mail, or any other activities not directly related to class. No headphones, blue tooth earphones, etc. are to be used in the classroom. No cell-phone calls, rings, musical interludes, etc. allowed during class. If you have a work related or family emergency that requires you to take a call during class, please inform me of this situation in advance of each class period. If you violate these class room policies, you will be asked to leave the class and not return until the next class period in respect of other student's need to focus on class work.

Religious Holidays To be complied with the university policy regarding religious holidays.

Attendance Policy

Students are expected to be present for every meeting of classes. Any anticipated absences must be cleared with the instructor, in advance or the absence will be considered unexcused. A student may have no more than two unexcused absences. Three unexcused absences will result in a grade reduction of one letter grade. Four unexcused absences will result in a grade of "I" in the course.

Disability Support Services

Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information please refer to: <http://gwired.gwu.edu/dss/>

Emergency Preparedness

For emergency preparedness information, please refer to: <https://smhs.gwu.edu/about/emergency-preparedness-resources>

SYLLABUS

WEEK	DATE	TOPICS
BASICS		
Week 1	Aug 31	<p>Course Introduction Some important definitions Environmental issues and scales Environmental sciences</p> <p>Causes of Environmental Problems Environmental supply and human demand Human population growth and associated demand Pollution Case study: Minamata disease</p> <p>Goal of Environmental Science Concept of sustainability Scientific principles for maintaining natural sustainability Earth carrying capacity</p> <p>Environmental History: An Overview</p>
Week 2	Sep 7/14	<p>Scientific Principles and Concepts Understanding what science is Observations, Facts and Interferences Controlling variables Nature of scientific proof Theory in science and language Models and Theory</p> <p>Measurements and Uncertainty A word about numbers in science Dealing with uncertainties Accuracy and precision</p> <p>Misunderstanding about Science and Society Science and decision making Science and technology Science and objectivity Science, pseudoscience and frontier science</p> <p>Environmental Questions and the Scientific Method</p>
Week 3	Sep 14	<p>System Approach, Global Energy Budget and Redistribution System and its components; feedback loops and coupling Behavior of complex systems: time delay/synergy/resistance Black body radiation and earth surface temperature Global energy budget and greenhouse effect Global energy redistribution: earth surface fluid circulation</p>
LITHOSPHERE		
Week 4	Sep 21	<p>Past, Current, and Future of the Earth Origin and evolution of the earth and the solar system Physical and Chemical Structure of the solid Earth</p>

Earth Materials and Mineral/Rock Resources

Rocks and Minerals classified by their compositions
Elements' crustal abundance and concentration factor for ores
Common economical minerals and their uses
Mineral and rock resource and related environmental issues

Week 5	Sep 28	Energy Resources Nonrenewable vs. renewable resources Geological process of fossil fuel formation Nuclear energy and nuclear waste Hydropower, geothermal, solar, and wind energy Environmental problems related to energy resource exploration
Week 6	Oct 5	Soil Science Weathering and soil formation; soil mineralogy Soil taxonomy and profile Soil chemistry: colloids, ion adsorption/exchange, alkalinity/salinity Soil water and hydrology Nutrient cycling and fertility
Exam 1	Oct 12	EXAM 1 ATMOSPHERE
Week 7	Oct 19	Atmospheric Science Basic composition Ideal Gas Law The structure of the atmosphere Basic atmospheric energetic: Pressure and Temperature Basic tropospheric and stratospheric and chemistry Ozone chemistry Chemistry of air pollution
Week 8	Oct 26	Air Pollution and Consequences-I: Greenhouse Gases and Global Climate Anthropogenic input of GHGs Evidence of anthropogenic CO ₂ buildup since industrial revolution Past climate and historical CO ₂ level Projected future CO ₂ level and associated T and sea level change Carbon reservoirs and fluxes Natural regulation of atmospheric CO ₂ : C cycles
Week 9	Nov 2	Air Pollution and Consequences-II: CFCs and Ozone Depletion Ozone in the atmosphere and the UV effect Mechanisms for CFC destroying ozone: Antarctic ozone hole Montreal Protocol and current state of CFC substitution Air Pollution and Consequences-III: SO₂, NO_x and Acid Precipitation Natural and anthropogenic sources of SO ₂ , NO _x Chemistry of acid precipitation formation Clean Air Act

HYDROSPHERE

Week 10	Nov 9	Water Resources and Hydrology Global water cycle: surface vs. groundwater Surface water: erosion and flooding Groundwater: Darcy's law Surface and groundwater interaction: salt water intrusion Hydrofracking: Groundwater contamination? Clean Water Act
Week 11	Nov 16	Interactions of Water with Atmosphere and Lithosphere Regulation of water pH by CO ₂ -H ₂ O equilibria Measure of water quality Control of water chemistry by mineral dissolution/precipitation Acid mine drainage
	Nov 23	THANKSGIVING
Week 12	Nov 30	Water Quality Water quality parameters and its measurement Waterborne disease Nutrients Water pollution Wastewater treatment Water reuse
	Dec 7/14	EXAM 2/PROJECT PRESENTATION