

ENVIRONMENTAL SCIENCE 201

ENV-SCI 201: EARTH: A HABITABLE PLANET ?

COURSE DESCRIPTION: This course presents a broad description of Earth System Sciences focused on the Physical, Chemical, and Biological processes that have made Earth habitable, and how humans are affecting these processes. The first area of focus is to retrace the evolution of the planet from the early ages, when the laws of physics and chemistry ruled, to the apparition of life and the homeostatic conditions that resulted. The second is to describe, and show how we can quantify, the major biogeochemical cycles that play a central role in this homeostatic equilibrium. The third component is to assess the impact of human activities that are leading to major environmental changes in our environment and discussing and the decisions that humanity will be faced with.

PREREQUISITES:

- MATH 214-2 or equivalent, CHEM-103 or CHEM-172 or equivalent.

BOOKS:

- ***The Earth System:*** Lee R. Kump, James F. Kasting, Robert G. Crane. Pearson/Prentice Hall.

RECOMMENDED READING:

The books listed below are general read and present a very good way to have a historical perspective on the evolution of scientific thought and human societies. This is basic knowledge that is key for understanding the complex world that we live in. During the quarter I will make some specific reference to chapters from these books that can be read independently. This list is by no means exhaustive.

- ***A Short History of Nearly Everything:*** Bill Bryson. Great coverage of the history of science and how humans came to discover how the planet works. It is available in paperback.
- ***Collapse: How Societies Choose to Fail or Succeed:*** Jared Diamond. A very interesting perspective on how environmental problems have lead to the collapse of ancient societies. Available in paperback.
- ***The View from the Center of the Universe:*** Joel Primack and Nancy Abrams. The special place that the Earth occupies in the Universe and some important information and concepts about energy.

TIME:

- Class meets on MWF from 1:00 – 1:50 p.m. SEARLE 1421
- Discussion section on TH in TECH L-251 from 12:30 – 1:50 p.m.

OBJECTIVES:

- Develop a conceptual framework for defining environmental issues.
- Provide a description of the earth from a chemical perspective with links to physical and biological processes.
- Stress the complexity of the earth system as well as the interconnectivity of all the major processes that make the planet habitable.
- Develop a sense of the implications of sustainable development.
- Teach students how to integrate information and probe the Earth system with simple dynamic models.

OUTCOMES: Upon completion of this course students will be able to:

- Describe the bio-geo-physico-chemical processes that maintain the Earth in a homeostatic and dynamic state.
- Recognize the complexity of the Earth system and the interdependence of environmental processes.
- Apply a scientific approach to the investigation of events in daily life.
- Analyze a specific environmental situation within a large context.
- Assess how current and future human activities may affect the Earth System.

For the engineering student, the course primarily supports the following ABET program outcome criteria:

- (a) An ability to apply knowledge of Earth science.
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and social context.
- (i) A recognition of the need for, and an ability to engage in life-long learning
- (j) A knowledge of contemporary issues.

EVALUATIONS:

- Homework: Problem sets and short essays will be assigned - 20%
- Weekly quizzes will be given in class under the form of multiple choices questions that will stress concepts. - 40 %
- The final exam is under the form of a team project stressing the relationships between the planet resources and human use - 25%
- Class participation 15%

TENTATIVE SCHEDULE:

WEEK 1:

- M** Introduction: Early Evolution & Composition of the Universe
- W** Gaia Hypothesis
- F** Rise of Oxygen

WEEK 2:

- M** Earth System: Concepts
- W** Daisyworld Climate System
- F** Feedback Loops

WEEK 3:

- M** Earth Climate: Global Energy Balance
- W** Radiation Balance, Black Body Radiation
- F** Albedo, Greenhouse Effect

WEEK 4:

- M** Atmospheric Composition and Structure
- W** Atmospheric Particles and their Catalytic Role
- F** Introduction to Climate Modeling and Climate Feedbacks

WEEK 5:

- M** The Ocean: Chemical and Physical Aspects
- W** Ocean Circulation
- F** Acids, Bases, and Salts

WEEK 6:

- M** Water in the Atmosphere, Acid Rain
- W** Water in Soils, Weathering Reactions.
- F** Effects of Acidification

WEEK 7:

- M** Modeling the Atmosphere-Ocean System
- W** General Circulation Models (CGMs)
- F** Climate Change

WEEK 8:

- M** Global Biogeochemical Cycles of C, N, S, and P
- W** Carbon and Nitrogen Cycles
- F** Phosphorus and Sulfur Cycles

WEEK 9:

- M** Climate Sensitivity/Stability
- W** Global Warming
- F** Conclusions

WEEK 10: PRESENTATIONS/DISCUSSIONS OF THE CLASS PROJECT.