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HC88 The Earth: How It Works **S94**

Prerequisites: None (4 units; lower division)

Director: Professor Richard Turco; MS 7157; Phone 825-6936

Course Requirements:

Examinations: Mid-Term and Final Exam;

All exams will be closed-book in a true/false and multiple-choice format;

Grading: The course grade will be determined by the following weighting of the course requirements:

Mid-term, 60 points; Final Exam, 90 points; Total points = 150.

The distribution of letter grades will adhere to the standards established for Honors Collegium courses.

Class Notes: No textbook has been assigned for the course. Class notes will be distributed during the quarter.

Structure: Each class session will consist of two seminars presented by experts in the earth and life sciences. The seminars will be about 1:15 in length, with the last fifteen minutes devoted to an open discussion with the lecturer. There will be a break of 10 minutes between lectures. Students are invited to ask questions during the presentations and the discussion sessions.

Summary: A number of current global environmental problems are the result of widespread emissions of pollutants into the atmosphere and oceans. These global-scale problems generally involve human activities that are important to society. Specific examples include the disturbance of the global climate associated with emissions of carbon dioxide formed during the combustion of coal and oil, and depletion of the stratospheric ozone layer caused by the manufacture and release of chlorofluorocarbons used for refrigeration and air conditioning. The Earth's environment is a complex system comprising the atmosphere, oceans, land, and all living organisms — the biosphere. Each element of the system is being influenced to a degree by human activities. Moreover, the various elements are connected, and together determine the overall response of the global environment to human stress. To understand the nature of, and to find solutions to, global environmental problems, citizens, scientists and policy makers must have a broad understanding of the integrated environmental system. Students will be offered an overview of the Earth as a system of distinct, yet intimately connected, physical and biological elements. The origins and characteristics of the atmosphere, oceans, and land masses are described. The evolution of life, particularly in relation to the evolution of the physical world, is surveyed. Similarly, the effects of biological processes in shaping the physical environment are defined. The mechanisms that drive the climate of the Earth, and that have produced a protective ozone shield around our planet, are also described. The possibility of technological solutions to global pollution problems is explored in the context of knowledge gained during the course.

Disciplines: The course is designed to introduce students to their global environment, and provide them with the knowledge to make informed decisions concerning the environment. The course will appeal to students in all curricula, including the social sciences and fine arts, the physical sciences, engineering and biological sciences who wish to learn more about current global environmental issues.

HC-88. The Earth: How It Works Summary of Lectures

- Apr. 5 **Introduction to the Earth:** The Earth as a planet; properties and facts about the Earth today; the atmosphere, oceans, and land masses; approaches for study of the Earth system.
- Evolution of the Earth:** The formation and early history of our planet; geological evolution; the interior of the Earth; the continents; Earth compared to other planets.
- Apr. 12 **The Crust and Lithosphere:** The solid outer layers of the Earth; plate tectonics; mountains and trenches; earthquakes; volcanoes.
- Earth History and Global Change:** Origins of rocks; the geological time scale; secrets held in the rocks; paleomagnetism and earth history.
- Apr. 19 **The Atmosphere:** Principal composition of the atmosphere; the discovery of air; the origins of nitrogen and oxygen; the roles of trace constituents; the ozone layer.
- The Cycle of Water:** Origin of water for the Earth; evaporation and condensation; clouds and precipitation; streams, rivers and lakes; water in the ground; snow, ice and glaciers.
- Apr. 26 **The Oceans — Physical Aspects:** The major ocean basins; the principal ocean currents; composition and temperature of the oceans; oceans and carbonates.
- The Oceans — Biological Aspects:** The origin of life; marine life forms; nutrients and the marine food chain; the oceanic carbon cycle; the marine sulfur cycle.
- May 3 **The Sun:** Properties of the sun and sunlight; sunspots and other disturbances; variations in the output of the sun; ultraviolet radiation and its effects.
- The Climate System:** Definitions of climate and weather; climate as an energy machine; thermal radiation from the Earth; a simple energy balance model; factors that affect climate.
- May 10 **Greenhouse Effect:** The greenhouse effect; gases that contribute to the greenhouse effect, including carbon dioxide; increasing greenhouse gases; the role of clouds; predictions of global warming.
- Midterm Examination**
- May 17 **Recent Climate Change:** The recent climate of Earth; the Holocene and human civilization; ice ages, Milankovitch cycles, and little ice ages; climate change induced by human activities.
- Sea Level and Climate:** Changes in sea level over geological and historical periods; Pangea, continental drift and climate; Cretaceous versus modern climate.
- May 24 **Atmosphere/Ocean Interactions:** How the atmosphere and oceans are coupled; the water cycle, clouds and energy; the thermohaline circulation; El Nino events; typhoons.
- Ocean/Atmosphere/Ice:** Roles of ice in climate change; history of the ice sheets; ice/ocean connections; melting of ice sheets and sea level rise.
- May 31 **Land Biology:** The distribution of life on land; forests and deforestation; roles of animals; humans and their impact on the land; agriculture.
- Land Surface Processes in Climate Change:** Vegetation effects on reflectance and evaporation; soils, water and runoff; response of land biota to climate change.

Jun. 7 **The Ozone Layer and Ozone Hole:** Origin and properties of the ozone layer; ozone and ultraviolet radiation; chlorofluorocarbons and ozone depletion; ozone depletion over Antarctica; causes of the ozone hole.

Engineering the Environment: Modifying the climate system; effects of airborne particles; compensating for the greenhouse effect; fixing the ozone layer.

Jun. 16 **Final Examination**