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College of Science and Health
ENVIRONMENTAL SCIENCE & GEOGRAPHY
Course Outline

1. TITLE OF COURSE AND COURSE NUMBER: Earth Through Time
ENV 220, 4 credits

2. DESCRIPTION OF THE COURSE: The study of the origin and evolution of the Earth and life as revealed by the geological record in the rocks. Includes the concepts of relative and absolute geologic time, plate tectonics and sea-floor spreading; the origin, growth and drift of the continents; the rise and fall of mountain ranges; the advance and retreat of the seas and glaciers and the evolution of plants and animals as shown by the fossil record. Major emphasis on the geological evolution of North America.

3. COURSE PREREQUISITES: ENV 115, General Geology.

4. COURSE OBJECTIVES: To provide students with an introduction to the history of life on Earth and the methods used to study that history.

5. STUDENT LEARNING OUTCOMES AND OBJECTIVES:
Upon completion of this course, students should be able to:
 1. Write well organized, thoroughly researched laboratory and field investigative reports.
 2. Demonstrate the ability to think critically by integrating paleontological data with Earth system history into coherent framework.
 3. Conduct literature research in Earth system history and integrate that research into laboratory and field investigations.
 4. Perform as an effective member of a field team during the collection of taphonomic, paleo-ecological and taxonomic data and merge that knowledge into a comprehensive document.
 5. Reproduce the geologic time scale and explain its historical development.
 6. Explain the history of the Earth, and especially North America, and the geologic processes that shaped it.
 7. Explain how life developed and evolved on Earth.
 8. Collect, analyze and use fossil data to describe conditions and life forms from the Earth's past from an actual site.

6. TOPICAL OUTLINE OF THE COURSE CONTENT:
Lecture Outline:
 - I. The Science of Historical Geology
 - Changing views on origin and history of the Earth and historical geology as a multidisciplinary or eclectic science; the "work" of historical geologists.
 - History of the science: Steno, Strachey, Werner, Hutton, Playfair, Smith, Lyell, Cuvier, Darwin, Walther, etc.
 - Introduction to sedimentary rock record

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II. Interpreting the Past Through Sedimentary Rocks

- Sedimentological archives: tectonic settings, depositional environments, marine vs. non-marine settings, transitional settings; size, texture, sorting, angularity, sphericity, roundness, fabric, surface features, cross structures, orientation and grading as clues to sources and types of deposition.
- Color of sediments
- Significance of texture
- Inferences from cross structures: mud cracks, cross bedding, ripple marks, geopetal structures, etc.
- Meaning and interpretation of:
 - Sandstones - quartz ss., arkose, greywacke, lithic ss.
 - Carbonates - Folk and Dunham classification and particle types, cementation and diagenesis
 - Shales - clay mineralogy, silts, clays, muds, fissility, etc.
 - Sedimentary rock record

III. Life Through Time

- Paleontology, taphonomy and trace fossils and the nature of the fossil record
- Taxonomy and classification
- Organic evolution, punctuated vs. gradualism
- Biostratigraphy and use of index fossils, cosmopolitan vs. endemic species, zonation.
- Paleoecology - fossils as clues to ancient environments.
- Overview of history of life on Earth
- Origin of life on Earth
- Fossils in the search for mineral resources

IV. Geologic Time

- Standard time scale
- Absolute time: radiometric dating and fission track dating
- Relative time: superposition, uniformity of process, cross-cutting relations and inclusions (reworked fragments and xenoliths), law of original horizontality, unconformities, index fossils and principles of succession, facies concept.

V. Development of Earth's Major Features

- Birth of solar system and knowledge thereof by lunar sample study and meteorites; the first 700 million years.
- Differentiation of early Earth as determined by seismicity
- Evolution of hydrosphere and atmosphere
- Plate tectonics - an introduction to basic concepts and effects of organisms.

VI. The Archeozoic - Early Precambrian

- Origin of shields/cratons
- Archean crust and origin
- Archean sediments
- Life of the Archean - origin of prokaryotes.
- Mineral wealth of Archean

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- VII. The Proterozoic - Late Precambrian
 - Continental growth by accretion
 - Early - Middle and Late Proterozoic events in North America
 - Proterozoic rock south of the craton
 - Precambrian events on other continents
 - Fossil record of Proterozoic
 - Changing Proterozoic environments
 - Mineral wealth of Proterozoic
- VIII. Early Paleozoic (Cambrian, Ordovician, Silurian, Devonian)
 - Lands, seas, orogenies and paleogeography of North America
 - Base of the Cambrian - Iapetus Sea
 - Early Paleozoic history
 - Global paleogeography during Early Paleozoic
 - Climatology of Early Paleozoic
 - Economic geology of Early Paleozoic
- IX. Late Paleozoic (Mississippian, Pennsylvania, Permian)
 - Lands, seas, orogenies and paleogeography of North America
 - Europe in Late Paleozoic
 - Gondwanaland in Late Paleozoic
 - Late Paleozoic history and paleogeography
 - Climatology of Early Paleozoic
 - Economic geology of Late Paleozoic
- X. Life of the Paleozoic
 - Plants
 - Invertebrates, marine and terrestrial
 - Vertebrate origins
 - Major extinctions
- XI. The Mesozoic Era (Triassic, Jurassic, Cretaceous)
 - Introduction
 - Breakup of Pangea and origin of Atlantic
 - Mesozoic History of North America
 - Eurasia & Tethys Seaway
 - Gondwanaland events
 - Economic resources of Mesozoic
 - Sedimentary basins
- XII. Life of Mesozoic (Triassic, Jurassic, Cretaceous)
 - Plants and changing climates
 - Invertebrates
 - Vertebrates
 - Extinctions
- XIII. Dinosaurs
 - Evolution, diversity, anatomy, physiology
 - Controversies
- XIV. Cenozoic Era
 - Introduction

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- Before the Ice Age: 65 M.Y. to 2 M.Y. ago
 - Changing climates, paleogeography
 - Giant lakes, encroaching seas
 - Sedimentary basins
 - Mineral resources
- XV. Life of the Cenozoic
- Expansion - diversity of mammals
 - Plants
 - Invertebrates
 - Vertebrates - Ice Age extinctions
- XVI. Human Origins
- Australopithecines, Homo Sapiens

7. GUIDELINES/SUGGESTIONS FOR TEACHING METHODS AND STUDENT LEARNING ACTIVITIES:

Lecture: Lectures and class discussion

Lab: “Hands on” laboratory exercises , field investigations at New Jersey sites

8. GUIDELINES/SUGGESTIONS FOR METHODS OF STUDENT ASSESSMENT (STUDENT LEARNING OUTCOMES):

Lectures: Three examinations, term research paper

Lab: Lab and field reports

9. SUGGESTED READINGS, TEXTS, OBJECTS OF STUDY:

Levin, The Earth Through Time, 7th Edition, 2003, John Wiley and Sons Publishing.
ISBN # 0-470-00020-1

10. BIBLIOGRAPHY OF SUPPORTIVE TEXTS AND OTHER MATERIALS:

Berry, W.B.N., 1987, *Growth of a Prehistoric Time Scale*, W.H. Freeman & Co., San Francisco.

Burchfield, J.D., 1975, *Lord Kelvin and The Age of the Earth*, The University of Chicago Press, Chicago, IL.

Colbert, E.H., 1973, *Wandering Lands and Animals: The Story of Continental Drift and Animal Populations*, Dover Publications, Garden City, New York.

Cutler, A., 2003, *The Seashell on the Mountaintop: A Story of Science, Sainthood, and the Humble Genius Who Discovered a New History of the Earth*, Dutton, NY.

Darwin, C., 1859, *The Origin of Species by Means of Natural Selection*, John Murray, London, England.

Eicher, D.L., 1976, *Geologic Time*, 2nd ed., Prentice Hall, Inc., Englewood Cliffs, NJ.

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Gould, S.J., 1987, *Times Arrow, Times Cycle: Myth and Metaphor in the Discovery of Geologic Time*, Harvard University Press, Cambridge, MA.

Leakey, R. E., and Lewin, R., *Origins: What New Discoveries Reveal About the Emergence of Our Species and Its Possible Future*, E.P. Dutton, NY

Repcheck, J., 2003, *The Man Who Found Time*, Perseus Publications, Cambridge, MA.

Wegener, A., 1929, *The Origin of Continents and Oceans*, translated (1966) by John Biram, Dover Publications, Inc., Garden City, NY.

Widmer, K., 1964, *The Geology and Geography of New Jersey*, D. Van Norstrand Company, Inc., Princeton, NJ.

Winchester, S., 2001, *The Map that Changed the World; William Smith and the Birth of Modern Geology*, Harper Collins, New York.

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12. ORIGINAL DEPARTMENTAL APPROVAL DATE: Fall 1979
13. REVISER'S NAME AND DATE: Richard Pardi, December 2004
14. DEPARTMENTAL REVISION APPROVAL DATE: Spring 2005