January 20, 2005

**College of Science and Health**
**ENVIRONMENTAL SCIENCE & GEOGRAPHY**
**Course Outline**

1. TITLE OF COURSE, COURSE NUMBER: Intro to Environmental Geochemistry
ENV 320, 3 credits

2. DESCRIPTION OF THE COURSE: This course provides an introduction to the basic concepts of geochemistry, with an emphasis on those concepts that are pertinent to Environmental Science.

3. COURSE PREREQUISITES: ENV 115 and CHEM 161

4. COURSE OBJECTIVES: To provide students with a thorough understanding of the geochemical basis of environmental science, particularly with reference to dynamic natural systems.

5. STUDENT LEARNING OUTCOMES:
By the end of the course, students should be able to:
1. Effectively express themselves in written and oral form on topics dealing with geochemistry
2. Demonstrate the ability to think critically about geochemical issues through either writing or discussion
3. Locate and use information, specifically in geochemistry, for use in a research paper
4. Demonstrate the ability to integrate geochemical and environmental knowledge and ideas in a coherent and meaningful argument or presentation
5. Work effectively with others on a research project
6. Describe the abundance and distribution of the elements in the natural environment
7. Explain the basic concepts of thermodynamics, radioactive and stable isotope behavior, and solutions
8. Discuss the cycles of carbon, nutrients, and trace elements in natural systems
9. Perform a number of geochemical calculations for reacting systems

6. TOPICAL OUTLINE OF THE COURSE CONTENT:
- I. Introduction
- II. The Elements
  - X abundance of the elements in meteorites and on earth
  - X geochemical classification of the elements
- III. Thermodynamics
  - X historical development and basic concepts
  - X first and second laws of thermodynamics
  - X the Gibbs function
  - X chemical equilibrium
  - X chemical potential, fugacity, and activity
  - X the phase rule

X phase diagrams

IV. Water Chemistry
- X basic properties of water
- X solutions and solubility
- X pH
- X oxidation and reduction reactions
- X Eh
- X Eh-pH diagrams
- X evaluation of water analyses
- X characteristics of natural waters

V. Isotope Geochemistry
- X isotopes, radioactivity, and geochronology
- X radioactive isotope systems (Rb-Sr, Sm-Nd, U-Th-Pb, K-Ar, $^{14}C$)
- X stable isotope systems (O, H, S, C, N)

VI. Organic Geochemistry
- X organic chemistry and natural organic compounds
- X the carbon cycle
- X nutrient cycles
- X trace element cycles
- X organic geochemistry of freshwater systems
- X organic geochemistry of saline systems
- X coal and petroleum

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

Lecture and class discussion

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

Mid term and final exams, problem sets

9. SUGGESTED READINGS, TEXTS, OBJECTS OF STUDY:

Brownlow, Arthur H., *Geochemistry (2nd edition)*
Selected papers from the current literature

10. BIBLIOGRAPHY OF SUPPORTIVE TEXTS AND OTHER MATERIALS:

Stumm, W. and J.J. Morgan (1996). "Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters", (3rd Edition), John Wiley & Sons, Inc.
Drever, James I. (1997). "The Geochemistry of Natural Waters: Surface and Groundwater Environments", (3rd Edition), Prentice Hall, Inc.

11. PREPARER'S NAME AND DATE: Karen Swanson, Spring 1997

12. ORIGINAL DEPARTMENTAL APPROVAL DATE: Spring 1997

13. REVISER'S NAME AND DATE: Karen Swanson and Richard Pardi, Spring 2004

14. DEPARTMENTAL REVISION APPROVAL DATE: Spring 2004