Put your chemistry to work!

Overview

- Applied chemistry in the context of soil and environmental sciences.
- We focus on the retention and mobility of metals, nutrients, and organic chemicals in soils and sediments.
- Its purpose is to prepare students to understand and predict the fate of nutrients and pollutants in soils and sediments of natural, agricultural, and industrial ecosystems.

INSTRUCTOR

Michael Thompson
Email: thompsonm@iastate.edu

PREREQUISITES

Two semesters of college chemistry
Two semesters of soil science, geology, or comparable environmental sciences courses
One semester of college algebra

TEXTBOOKS

Soil and Water Chemistry: An Integrated Approach (M.E. Essington, CRC Press, 2004)
Laboratory Manual (handouts)

CLASS SCHEDULE

MWF	11:00 am	Agronomy 1022
Th	1:10 – 4:00 pm	Agronomy 2419

OVERALL COURSE OBJECTIVES

- Learn to apply fundamental chemical concepts to practical problems in environmental sciences
- Deepen understanding of chemical processes in soils and sediments
- Become familiar with standard techniques to assess the retention and mobility of nutrients and contaminants in soils and sediments

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This course will be offered at either the 400-level or 500-level. Those students who take the 500-level version will learn to use an equilibrium geochemical model called MINTEQ.

LABORATORY STUDIES

Soil pH, electrical conductivity, dissolved organic matter
Copper complexation by soil extracts
Active iron oxides
Total iron oxides
Introduction to x-ray diffraction analyses of clay minerals and infrared analyses of organic matter
Exchangeable cations and anions
Total and soil-test zinc
Zinc adsorption
Total and soil-test phosphorus
Phosphorus adsorption
Dispersion / coagulation of colloids

LECTURE-DISCUSSION SESSIONS

A. SOLUTION-PHASE CHEMISTRY

1. Atoms and ions: Electronegativity, ionic potential, electronic configurations
2. Ionic strength and chemical activity
3. Acids and bases in natural waters
4. CO_2 and carbonate in solution
5. Buffers and titrations
6. Hydrolysis reactions, including metal hydrolysis
7. Dissolved organic matter: Functional groups and compounds; titrations
8. Complexation reactions: Metals
9. Redox reactions

B. SOLID-PHASE CHEMISTRY

1. Carbonate, sulfate, phosphate minerals
2. Sesquioxides: Fe, Al, Mn oxides
3. Silicates: Quartz, feldspar, and others
4. Layer silicates: Kaolinite, mica, vermiculite, smectite
5. Organic matter in soils and sediments

C. SOLID-SOLUTION INTERFACE

1. Interface chemistry
2. Inorganic adsorption reactions
3. Organic adsorption reactions

D. COLLOID CHEMISTRY

1. Double-layer models
2. Dispersion / coagulation phenomena
3. Colloid mobility

E. ENVIRONMENTAL AND AGRICULTURAL ISSUES

1. Soil acidity: Sources, alkalinity, liming
2. Soil salinity
3. Bioavailability: Nutrients, metals, organics
4. Phosphorus in soils and sediments
5. Chemical reactions in wetlands: Metals and organic matter
6. Acid mine spoil, drainage, and lakes
7. Pesticides: Fate in soils
8. Pharmaceuticals: Antibiotics and hormones