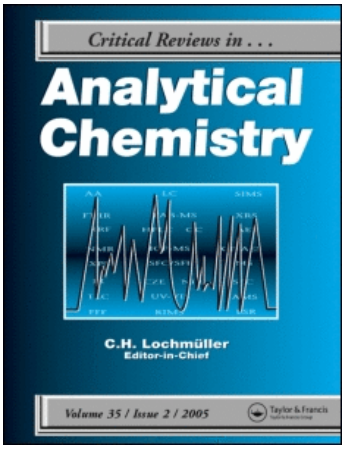

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ENVIRONMENTAL CHEMISTRY EDUCATION:

AN ISSUES COURSE IN ENVIRONMENTAL CHEMISTRY

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Science students are drawn to environmental chemistry because they hope to put their training to use in a societal context. Environmental issues provide a wonderful nexus of human concerns and interesting chemistry. A course is outlined below in which a series of environmental issues are weighed against a backdrop of intersecting chemical systems, involving energy, the atmosphere, the hydrosphere and the biosphere. The philosophy of the course is that chemistry provides insight into the workings of the natural world, and that many environmental problems can be understood as disturbances of chemical cycles that have always been in place. Concepts of energy and entropy flows, chemical thermodynamics and kinetics, molecular and electronic structure, intermolecular forces and molecular recognition are key to this understanding, and can be threaded through the environmental narrative on a "need to know" basis.

Students in the course have had one year of introductory chemistry, but are otherwise drawn from a wide range of disciplines. The course is suitable for students who plan to continue with environmental studies, and also for those who simply want greater familiarity with environmental matters. Science and engineering students especially appreciate the opportunity to learn how the chemistry they have learned can be applied to understanding environmental problems. The course includes problem solving, with examples drawn from a range of environmental concerns.

CHEMISTRY OF THE ENVIRONMENT

PART I ENERGY

A. Introduction

1. Natural Energy Flows
2. Human Energy Consumption

B. Fossil Fuels

1. Carbon Cycle
2. Origins of Fossil Fuels
3. Fuel Energy
4. Petroleum
5. Gas
6. Coal

C. Nuclear Energy

1. Fission
2. Naturally Occurring Radioisotopes
3. Radioactivity: Biological Effects of Ionizing Radiation
4. Fission Reactors
5. Hazards of Nuclear Power
6. Is Nuclear Power Part of the Future?
7. Fusion

D. Renewable Energy

1. Solar Heating
2. Solar Electricity
3. Biomass
4. Hydroelectricity
5. Wind Power
6. Ocean Energy
7. Geothermal Energy

E. Energy Utilization

1. Heat Engine Efficiencies: Entropy
2. Fuel Cells
3. Electricity Storage: the Hydrogen Economy
4. Systems Efficiency: Transportation, Materials and Recycling
5. Energy and Well-Being

PART II ATMOSPHERE

A. Climate

1. Radiation Balance
2. Albedo: Particles and Clouds
3. Greenhouse Effect
4. Climate Modeling

B. Oxygen Chemistry

1. Kinetics and Thermodynamics
2. Free Radical Chain Reactions
3. Oxygen Radicals
4. Hydroxyl Radical
5. Transition metal activation of O_2

C. Stratospheric Ozone

1. Atmospheric Structure
2. Ultraviolet Protection by Ozone
3. Ozone Chemistry
4. Catalytic Destruction of Ozone
5. Polar Ozone Destruction
6. Ozone Projections
7. CFC Substitutes

D. Air Pollution

1. Pollutants and Their Effects
2. Photochemical Smog
3. Emission Control
4. Gasoline and Its Formulations

PART III HYDROSPHERE

A. Water Resources

1. Global Perspective
2. United States Water Resources
3. Water as Solvent and as Ecosystem

B. From Clouds to Run-off: Water as Solvent

1. Unique Properties of Water
2. Acids, Bases and Salts
3. Water in the Atmosphere: Acid rain
4. Water in Soil: Neutralization and Salinization
5. Effects of Acidification in the Environment

C. Lakes, Wetlands and Seas: Water as Ecological Medium

1. Biological Oxygen Demand
2. Eh/pH and Water Quality

D. Water Pollution and Water Treatment

1. Water Use and Water Quality
2. Water and Sewage Treatment
3. Health Hazards

PART IV: BIOSPHERE

A. Nitrogen and Food Production

1. Nitrogen Cycle
2. Agriculture
3. Nutrition

B. Pesticides and Herbicides

1. Pest Control
2. Herbicides

C. Toxic Chemicals

1. Acute and Chronic Toxicity
2. Cancer
3. Hormonal Effects
4. Organic Pollutants: Dioxins and PCB's
5. Toxic Metals