

University of Arkansas - Fort Smith
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General Syllabus

CHEM 4803 Chemistry of Environmental Pollutants

Credit Hours: 3 Lecture Hours: 3 Laboratory Hours: 0

Prerequisite: CHEM 2713 Organic Chemistry II

Effective: 2018~2019

I. Course Information

A. Catalog Description

Physicochemical, biochemical, and environmental properties and behaviors of selected environmental pollutants are examined, as are the molecular bases for their toxicities. Pollutants to be discussed include heavy metals, inorganics containing nitrogen, oxygen, and sulfur and a variety of organics including hydrocarbons, chlorofluorocarbons, carbocation and free radical generators. Uptake, distribution and metabolism of exogenous compounds in man are examined.

B. Additional Information - None

II. Student Learning Outcomes

A. Subject Matter

Upon successful completion of this course, the student will be able to:

1. Predict and account for the physicochemical properties, biotic and abiotic fates of organic compounds based upon their structures.
2. Discuss (bio) chemical pathways of the main classes of organic pollutants and draw reasonable curved arrow mechanisms for reactions.
3. Identify the likely hazards associated with organic compounds and discuss reasonable and effective methods of storage and disposal.

B. University Learning Outcomes

Chemistry of Environmental Pollutants enhances student abilities in the following areas:

Analytical Skills

Critical Thinking Skills: Students will identify a problem or issue and will research, evaluate, and compare information from varying sources in order to evaluate authority, accuracy, recency, and bias relevant to the problems/issues. Students will generate solutions/analysis of problems/issues evaluated and will assess and justify the solutions and/or analysis.

Communication Skills (written and oral)

Students will communicate proficiently. Students will compose coherent documents appropriate to the intended audience and effectively communicate orally in a public setting.

Ethical Decision Making

Students will model ethical decision-making processes. Students will identify ethical dilemmas and affected parties and will apply ethical frameworks to resolve a variety of ethical dilemmas.

Global & Cultural Perspectives

Students will reflect upon cultural differences and their implications for interacting with people from cultures other than their own. Students will demonstrate understanding or application of their discipline in a global environment and will demonstrate how their discipline impacts or is impacted by different cultures.

III. Major Course Topics

- A. Brief review of organic chemistry concepts: Lewis structures, resonance, electron pushing; classes of organic compounds, oxidation levels; intermolecular forces, electrophiles and nucleophiles, free radicals, factors affecting reactivity. Chemical properties (volatility, solubility, sorption, persistence, reactivity)
- B. Basic Environmental Chemistry: The “Spheres”, turnover of chemicals between spheres, biological, chemical and physical agents in the spheres
- C. Impact of Chemicals on the Environment: natural emissions, air pollution phenomena, acid pollution, greenhouse effect, ozone depletion, halogenated hydrocarbons
- D. Conversion and Transformation of Organics: thermodynamics & kinetics of conversion/transformation, enzymatic conversions, chemical transformations, photolytic transformations
- E. Transport and Transport Models: Random motion, across boundaries, air-water exchange, box models, space-time models
- F. Toxicological concepts: Toxicity, Acute/chronic, reversibility, local/systemic, independent/additive/ synergistic/antagonistic, tolerance, factors modulating toxicity
- G. Uptake, distribution and elimination of chemicals: Transport (active and passive) via biological membranes, bioaccumulation; distribution of chemicals in organisms; excretion of chemicals from man
- H. Metabolism of Exogenous Chemicals in Mammals
 1. Overview of reaction types: Oxidations, Phase I, II conversions, Reductions, Hydrolyses, Conjugations

2. Overview of compound types: hydrocarbons, organonitrogens, organohalides, organosulfur compounds
 3. Toxic effects of chemicals: (a) lipid peroxidation, acidosis, oxygen deficiency due to effects on blood, uncoupling of oxidative phosphorylation, (b) effects the blood, the CNS, liver, kidneys, respiratory system, skin, (c) teratogenicity, genotoxicity, carcinogenicity
- I. Toxic effects of organics
 1. Unsaturation (alkenes, arenes) hydroxylation and epoxidation
 2. Carbocationogens (MeI, t-butyl halides, deamination,)
 3. Radical generators and initiators
 4. Chlorofluorocarbons
 5. Miscellaneous
 - J. Assessment of organic structures
 - K. Illustrative examples and Case Studies