

**Special Topics in Chemistry:**  
**ENVIRONMENTAL CHEMISTRY Spring, 2015**  
**CHEM 4980 Section 21      TR 4:00-5:15**

**Instructor:** Dr. Andy Jorgensen  
Bowman Oddy 2086F, 419-530-4579, fax -4033 [andy.jorgensen@utoledo.edu](mailto:andy.jorgensen@utoledo.edu)  
Office Hours: Mon & Wed 3-4 PM, Tue & Thurs 10:30-Noon

**Credit Hours:** 3    **Prerequisites:** Organic Chemistry II (CHEM 2420)

**Description:** This course will focus on the chemistry of air, water, and soil with specific emphasis on the effects of human-made chemical products and by-products on the environment. Connections with Green Chemistry will be highlighted. The course will be beneficial to chemists, chemical and environmental engineers, and environmental scientists. Specific topics are listed below in approximate order of coverage:

Introduction to Environmental Problems, Sustainability, and Green Chemistry

Triple bottom line; tragedy of the commons; systems thinking; life-cycle assessment; cradle-to-cradle; carbon footprint; ecological footprint; water footprint; external costs; history of environmental regulations; risk/exposure/hazard

Stratospheric Chemistry: The Ozone Layer (Chapter 1)

The physics, chemistry, and biology of UV; formation and destruction of ozone; the Chapman mechanism; catalytic processes of ozone destruction

The Ozone Holes (Chapter 2)

Dobson units; the chemistry of ozone depletion; the chemicals that cause ozone destruction; CFC replacements; international agreements

The Chemistry of Ground-Level Air Pollution (Chapter 3)

The chemical fate of trace gases in air; the photochemical smog process; improving air quality; limiting VOC and NO emissions; catalytic converters; sulfur-based emissions; particulates in air pollution

Environmental & Health Consequences of Polluted Air—Outdoors & Indoors (Chapter 4)

Acid rain; Outdoor Pollutants; Indoor Air Pollution

The Greenhouse Effect (Chapter 5)

Mechanism of the greenhouse effect; greenhouse gases; the climate-modifying effects of aerosols; geo-engineering

Energy Use, Fossil Fuels, CO<sub>2</sub> Emissions, and Global Climate Change (Chapter 6)

Global energy use and energy sources; CO<sub>2</sub> sequestration; predicted effects of climate change on human health; international agreements

Biofuels and Other Alternative Fuels (Chapter 7)

Bio-ethanol; bio-butanol; hydrogen; synthesis gas; methanol; fuel cells

The Chemistry of Natural Waters (Chapter 10)

Gas solubility; oxidation-reduction chemistry; the pE scale; acidity/alkalinity; drinking water chemistry issues

The Pollution and Purification of Water (Chapter 11)

Water disinfection; groundwater: its supply, chemical contamination, and remediation; treatment of wastewater and sewage

Toxic Heavy Metals (Chapter 12)

Mercury, lead, cadmium, arsenic, chromium

Pesticides (Chapter 13)

Persistent organic pollutants; bioconcentration; principles of toxicology; chloro-organic, organophosphate, and carbamate insecticides; herbicides: atrazines and glyphosate

Dioxins, Furans, and PCBs (Chapter 14)

Production and sources, commercial uses, health and environmental impacts

Other Toxic Organic Compounds of Environmental Concern (Chapter 15)

Polynuclear aromatic hydrocarbons; endocrine disruptors; phthalates; BPA; fire retardants; perfluorinated compounds

Wastes, Solids, and Sediments (Chapter 16)

Solid waste disposal; recycling; basic soil chemistry; contaminated sediments; hazardous wastes

**Exams:** Hour exams: Feb 17 & Mar 24; Final Exam: May 8<sup>th</sup> at 2:45 PM

**Textbooks:** Course material will primarily be taken from the text by Baird and Cann. Additional examples will be taken from scientific articles and the text by Manahan.

Baird, C.; Cann, M. *Environmental Chemistry*, Fifth Edition; W. H. Freeman and Company, New York; 2012. ISBN-13: 978-1-4292-7704-4.

Manahan, S. E. *Environmental Chemistry*, Eighth Edition; CRC Press, 2005. ISBN: 1-56670-633-5.

**Grading:** Grades will be based on two exams (100 points each), homework assignments and quizzes (150 points) and a comprehensive final exam (150 points). This totals 500 points. Grades will be assigned based the percentage of total points achieved:  
A/A- 90-100%, B+/B/B- 80-90%, C+/C/C- 70-80%, D+/D/D- 60-70%.

**Academic Dishonesty:** The University Policy on Academic Dishonesty will be strictly enforced. See: <http://www.utoledo.edu/dl/students/dishonesty.html>