

PLSCS 3650: Environmental Chemistry: Soil, Air and Water

2019

M.B. McBride

Lectures: MWF - 10:10-11:00 in 105 Bradfield Hall

Prerequisites:

Introductory college chemistry (1 year)
Soil Science 2600 (recommended)

Required Reading: Toxic Truth: A Scientist, a Doctor, and the Battle over Lead (2009)
Lydia Denworth

Class Materials: Powerpoint Lectures, Lecture Notes and Problem Sets will be posted on Blackboard

Problem Solving Session(s): 2 offered per week, Wednesday and Thursday afternoons.
(room locations and times to be determined)

Graduate Teaching Assistant: Taylor Cyle (ktc35@cornell.edu), 908 Bradfield

Office Hours:

Friday, 1-3 PM, 910 Bradfield Hall (M. McBride : mbm7@cornell.edu)

Grading:

	<u>Percentage of Final Grade</u>
Preliminary Exam (1) (tentative date : March 8)	25 %
Problem Sets (10)	30 %
Book Report (on “Toxic Truth”)	10 %
Final Exam	35 %

Problem sets will generally be posted weekly (Fridays) on Blackboard, and a “hard” copy of your answers will be due one week later at class time. There will be a 10 % late penalty for each day the problem set is late.

For the book report, students will be given a set of key questions about the book “Toxic Truth” several weeks into the semester, and will be asked to turn in their written report (TYPED!) with responses to these questions by the last study day before final exam.

Purpose of Course:

- To study the basic chemical nature and composition of soils, water and the atmosphere.
- To describe how elements and organic chemicals, both natural and anthropogenic, are mobilized, cycled and modified or degraded in the soil, water and air of the biosphere.
- To understand the degree to which human activity contaminates our environment, and impacts ecosystems and the health of plants and animals.

Lecture Outline for PLSCS 3650: Environmental Chemistry

Section 1 : Introduction to Chemistry

- The Periodic Table and Electronegativity of Elements
- oxidation states of elements
- bonding and Lewis dot diagrams
- types of chemical reactions

Section 2 : The Biosphere

- A. Elemental Composition of the Universe
- B. Elemental Composition of the Earth's Biosphere
 - early atmosphere, lithosphere and hydrosphere
 - evolution of life and impact on biosphere

Section 3 : The Composition of the Lithosphere (Soils)

- major and minor (trace) elements in the lithosphere
- chemically anomalous soils
- the link of soil composition to disease

Section 4 : The Hydrosphere and Atmosphere

- A. Hydrosphere
 - the hydrological cycle
 - chemical composition of freshwater, seawater
 - conservative and non-conservative elements
 - evaporite formation in seawater
 - pH buffering in lakes, acid-rain effects
- B. Atmosphere
 - structure and composition
 - N₂ and O₂ cycles

Section 5 : Pollution of the Biosphere – Excess Nutrients

- human disturbance of global C,N,P, S cycles
- N and P cycles in soils
- Problem of N and P imbalance on livestock farms
- eutrophication of surface waters, algal blooms, hypoxia

Section 6 : Pollution of the Biosphere – Toxic Metals

- definitions of “pollution” and “contamination”
- common soil and water pollutants
- historical trends and impact of metal pollution
- major sources of metal contaminants in soils and water
- geographical distribution of metal contamination

Section 7: Pollution of the Biosphere – Synthetic Organic Molecules

- agricultural pesticides
- plastics and plasticizers
- detergents and surfactants
- organohalide solvents

Section 8 : Persistent Organic Pollutants (POPs)

- A. Important POPs
 - PCBs
 - dioxins
 - polybrominated compounds (PBBs, PBDEs)
 - PAHs
 - perfluorinated compounds (PFOAs)
- B. Long-range transport of POPs

Section 9: Pollution of the Atmosphere - Greenhouse Gases

- the “greenhouse effect”
- carbon dioxide and the carbon cycle
- processes of CO₂ removal from and release to atmosphere
- trends in global warming

Section 10: The Limits of Science

- scientific uncertainty and fraud
- misuse of statistics and risk assessment