DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
CHEMISTRY 3412, WINTER 2019
ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY

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Course Description: This is a course in *environmental* toxicology and chemistry. That is, an examination of the chemical properties which contribute to toxicity, transport and chemical reactions across environmental "compartments." We will also discuss the biological effects of broad classes of organic toxins, including secondary metabolism and biological targets.

It is assumed that you have a sound knowledge of general chemistry and basic organic chemistry (i.e., one year or equivalent of each). Having taken other, upper-division CHEM or introductory biochemistry courses may be beneficial as well; however, these are not necessary and concepts from other specialized sub-disciplines of chemistry and biochemistry will be brought in and discussed as appropriate.

Textbooks: There is one textbook listed for this course. There are required readings from this textbook, and I highly suggest obtaining a copy.

- Suggested: Sterner, O; *Chemistry, Health, and Environment,* 2010, Wiley-Blackwell, ISBN: 978-3-527-32582-5

I will also be drawing off of the following textbooks, although these are not necessary to purchase:

- Schwarzenbach, Gschwend, and Imboden (SGI); *Environmental Organic Chemistry, 2nd Ed*, 2003, Wiley-Interscience, ISBN: 978-0-47-135750-6
- Crosby, DG; *Environmental Toxicology and Chemistry*, 1998, Oxford University Press, ISBN: 978-0-19-511713-4

Other Resources: In addition to the textbook, lecture presentations, and handouts, you will have the opportunity (and expectation) to consult other resources. These will consist of websites (laboratories, trade associations, government sites, user groups, and list-servers), electronically available journals, and paper-based journals. Most journal articles published pre-1970 to present are available in electronic format and may be printed and/or stored in journal publication format as *.pdf format. Two examples of where to look are as follows: A) the ACS journals (pubs.acs.org) are available from any DU-based URL; and B) many other journals are available free of charge from several databases available at the DU Library website (www.library.du.edu/). The most useful databases are A) www.sciencedirect.com, "Sciencedirect", a service with > 1000 full-text journals which the DU library subscribes to, and B) the Web of Science, which can be accessed directly from the Penrose Library webpage (search the Databases at http://library.du.edu/site/). All of the library databases are available without a personal account

from any campus-based URL; however, you can access them from off-campus through the DU library's website with proxy identification.

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Course Topics

I. Environmental transport (fugacity models – see handouts)

- *Types of chemicals*
- *Partitioning*
- *Bioaccumulation (Sterner Section 4.3)*
- *Fugacity models*

II. Chemical transformations (Sterner, 153 – 173)

- *Abiotic and biotic*
- *Importance of weak acid-base chemistry*

III. Toxicology (Sterner, 175-233 – specific sections announced in class)

- *Quantitative toxicology*
- *Dose-response relationship (s-curve)*
- *Important of chemical structure*
- *Metabolism*
- *Toxicology endpoints*
- *Airborne pollutants (Sterner 83 – 86)*

IV. Nuclear radiation (Lecture notes and 9.4.8)

- *Sources and background*
- *Effects of nuclear radiation on human cells*

V. Student Presentations (see details at the end of the syllabus)

Note that this class is not a prerequisite for any further classes. Therefore, this schedule is ***extremely*** flexible. If you want to go deeper into a topic currently under discussion or if there is a general consensus that we should skip something so we can get into other topics, then say so!

Evaluation Methods

Over the 10 week quarter, you will be evaluated by several criteria. Specifically, you will be expected to complete the following:

- Two 75 min exams – the 2nd will be during the Final Exam period.
- 3-4 problem sets, to be assigned roughly every other week.
- 1 group 20-22 min (+3 min questions) risk assessment presentation, including a 1 page written summary, described in detail at the end of the syllabus.

In the event that you must miss an in-class exam, let me know ASAP (in advance if possible) and a makeup will be scheduled. I am generally reasonable, but reserve the right to deny makeup

exams for confabulated reasons, in which case your missed exam will be counted as a zero.

The breakdowns, immediately below, reflect the "default" grading distribution. As with everything in life, **this is negotiable.** If you believe that you would perform better with different weightings, then we can meet in-person to discuss this. If you do not meet with me before **Tuesday, January 15**, then you will be relegated to the default distribution.

* Summary of evaluation:

Exams (2 x 25)	= 50 %
Participation	= 5 %
Final Project	= 25 %
Assignments	= 20 %

A	≥ 93 %	C	≥ 69 %
A-	≥ 90 %	C-	≥ 65 %
B+	≥ 87 %	D+	≥ 62 %
B	≥ 83 %	D	≥ 58 %
B-	≥ 80 %	D-	≥ 54 %
C+	≥ 74 %	F	≤ 54 %

I reserve the right to make downward adjustments to this scale (i.e. adjustments in the direction of leniency). In no event will the actual scale used be adjusted upward from that described above.

Important Dates:
January 7: Classes begin
January 13: Last day to drop a class (with nothing on your record)
January 21: MLK Jr Day – University closed
February 17: Last day to drop without approval
March 4: Last day to drop a class - final
March 14: Last day of class
March 19: Final Exam: 8:00 – 9:50, Olin 103

Special Project:

In the last week of this course, you will lead a 25 min (20-22 min presentation + 3-5 min discussion) presentation. Given the time-constraints of our class, **it is important that you stick to these limits**. In addition, a **1 page maximum** (single-spaced, 12 pt Times New Roman or 11 pt Arial, title page and references excluded) Executive Summary of your findings will be turned in on the date of your presentation. You will work in groups of 2-3, and you are free to choose whom you will work with and present your chemical of interest. The purpose of this project is for you to perform a full analysis of one pollutant. You will be expected/required to read and understand the current scientific literature relevant to your topic. Some useful journals include*: Environmental Science & Technology, Inhalation Toxicology,* and others. Your report and presentation should include the following:

1. A background of the chemical (what are its uses and how is it released into the environment?)
2. Relevant physical and chemical properties of your chemical (volatility, partition coefficients, etc).
3. Environmental equilibrium concentrations after release of x kg pollutant, using the Level I fugacity model. See http://www.trentu.ca/academic/aminss/envmodel/ and then click "Models" to download the Level I model.
4. Toxicity routes and target organs.

Please be prepared to lead the class for your presentation. Here are some tips for a successful discussion:

1. You are free to use slides, powerpoints, demonstrations, skits, or anything else which will help the class learn the material. Feel free to have an interactive portion, as well.
2. This is not a trivial task – I suggest that you start researching at the beginning of the quarter.
3. I am happy to meet with your group as much as you'd like for consultation. However, you are **required** to meet with me **twice** during the quarter.

Relevant Dates for the Special Project:

- Thursday, January 10: Turn in one piece of paper for each group. This paper should contain 1) the names of each group member and 2) your preferred organic chemical.
- Tuesday, January 15: I will approve your choice or suggest an alternative (in class).
- Thursday, January 31: Deadline for **Meeting #1**
- Thursday, February 28: Deadline for **Meeting #2**
- March 12 and 14 – Presentations

Presentation grade break-down:

One grade will be assigned to the group as a unit, with the exception of the peer and partner grade components (15% of presentation grade).

Preparation (5 *pts*)
- Meeting #1 (prior to January 26) (2.5 *pts*)
- Meeting #2 (prior to February 23) (2.5 *pts*)

Content (*35 pts*)
- Appropriate scope (7.5 *pts*)
- Background and motivation (7.5 *pts*)
- Relevant and correct chemistry/concepts (10 *pts*)
- Summary/Conclusions (*5 pts*)
- Answers to questions (5 *pts*)

Form and style (*30 pts*)
- Slide quality (uncluttered, clear) (*10 pts*)
- Clear explanations (5 pts)
- Verbal quality, eye-contact, body-language (*5 pts*)
- Team balance (*5 pts*)
- Timing (*5 pts*)

Executive Summary (*15 pts*)

Peer and partner grade (*15 pts*)