

CHEMISTRY 302 - Fall 2017

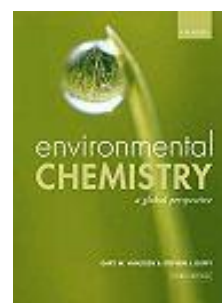
Atmospheric Environmental Chemistry

Introduction to the structure, composition and chemical processes occurring in the Earth's atmosphere with an emphasis on the application of kinetics to gas phase reactions. The fate, distribution and abatement of atmospheric contaminants will be examined. Topics include atmospheric transport, acid rain, photochemical smog, stratospheric ozone depletion and greenhouse gases.

Instructor: Dr. Erik Krogh **Office:** B360-Rm328 **Phone:** 753-3245, loc. 2307
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Required Textbook:

Environmental Chemistry: A Global Perspective (3rd Ed), **G.W. van Loon; S.J. Duffy**, 2011



Recommended Optional Texts:

Introduction to Atmospheric Chemistry, **P.V. Hobbs**, Cambridge Univ. Press, 2000

Elements of Environmental Chemistry, **R. Hites**, Wiley, 2007

Prerequisites: CHEM 142 **Recommended:** CHEM 221

Time and Location:

Lectures	1:00-2:20	T Th , B360-Rm323
Seminars	1:30-2:20	F , B370-Rm243

Office Hours: **T, Th** 11:00-12:00 and **F** 10:00 – 11:00 (other times can be arranged)

Course Evaluation:

Final Exam	40%
Mid-Terms (Oct 17 & Nov 21)	20%
Assignments (4)	15%
Case Study	10%
Research Paper	10%
Participation	5%

Atmospheric Chemistry Library Resources

Air Composition and Chemistry, **P. Brimblecombe**, Cambridge Univ. Press, 1996

Introduction to Atmospheric Chemistry, **D. Jacob**, Princeton Univ. Press, 1999

Environmental Chemistry, **N. Bunce**, Wuerz Pub, 1994, *chap. 1-4*

Environmental Chemistry (4th Ed.), **C. Baird**, Freeman and Co., 2008, *chap. 1-6*

Peer reviewed primary literature (*Journals*) via *Web of Science literature database*

VIU Grade Scale

A+	90-100	B+	76-79	C+	64-67	D	50-54
A	85-89	B	72-75	C	60-63		
A-	80-84	B-	68-71	C-	55-59		

Absence Policy:

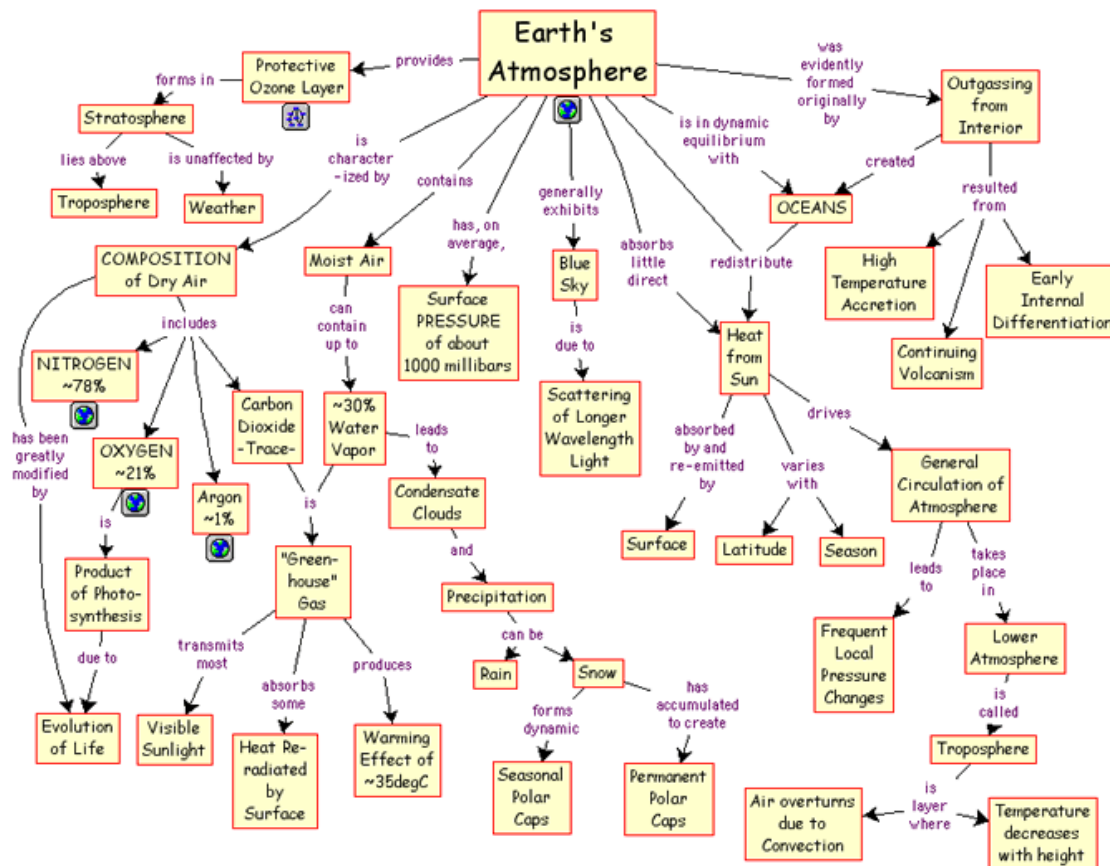
If a student is unable to write a quiz/test, has an acceptable reason, and I am informed before the examination is written, the student will be accommodated. It is unacceptable to notify me after the examination period and the student will usually receive a zero for this examination. The final examination will be comprehensive and will be scheduled during the final examination period. Last day for academic penalty-free withdrawal is Nov 2nd, 2015.

Academic Integrity Policy:

Cheating and plagiarism are serious offences. A detailed description of academic integrity, including the policies and procedures, may be found at <http://www.viu.ca/policies/documents/96.01-Mar21-11.pdf>

Disability Services:

If you require disability-related accommodations to meet the course objectives, please contact disability services Building 200, Room 214. For more information about Disability Resources or academic accommodations, please visit the website at: <https://www.viu.ca/disabilityservices/>



CHEM 302 – Course Outline

1. Introduction to Environmental Chemistry

Readings: Chapter 1

Course introductory comments
Earth properties, Environmental compartments, Residence time, Chemical processes
Review: Ideal gas laws, Kinetic molecular theory of gases, and Units of concentration

2. The Earth's Atmosphere

Readings: Chapter 2

Composition and Evolution of the atmosphere
Thermal structure and Solar influence on atmosphere
Reactions and Calculations in atmospheric chemistry
Biogeochemical cycling and more one residence times
Review of Kinetics and Thermodynamics

3. Stratospheric Chemistry: Ozone

Readings: Chapter 3

The ozone layer, Solar spectrum and Photochemistry
Chapmann reactions
Catalytic decomposition of ozone
Chlorofluorocarbon chemistry
Polar ozone hole formation

4. Tropospheric Chemistry: Smog

Readings: Chapter 4

Photochemical smog formation
Hydroxyl radical chemistry
Internal combustion engine exhaust

5. Tropospheric Chemistry: Precipitation

Readings: Chapter 5

Composition of rainwater
Atmospheric production of nitric and sulfuric acids
Rain, snow and fog chemistries
Short and long range acid transport
Control technologies for sulfur and nitrogen emissions

6. Atmospheric Aerosols

Readings: Chapter 6

Sources, concentrations and atmospheric lifetimes
Abatement strategies for particulate emissions

7. Chemistry of Urban and Indoor Atmospheres

Readings: Chapter 7

Pollutants in rural, urban and industrial airsheds
Indoor air quality, airborne contaminants and exposure thresholds

8. The Chemistry of Global Climate

Readings: Chapter 8

Thermal structures solar radiation balance revisited
IR absorption spectra, greenhouse gases and aerosols
Relative importance and global warming potentials of greenhouse gases
Carbon based fuels and alternative energy supplies

Case Studies: Student Lead Discussions and Presentations

Readings to be assigned



CASE STUDIES – Friday Seminar Series

Student seminar presentations and discussion on a current environmental issue related to air pollution, atmospheric chemistry, and/or air quality.

Objectives of Case Study Seminars:

- Provide an overview of a current environmental atmospheric topic
- Review relevant chemistry and reinforce core concepts and connections to course
- Critically evaluate mainstream media representations of scientific topics
- Comment on the economic, political and social context of the topic
- Stimulate interest and discussion

Responsibilities of discussion leader:

- Arrange a preliminary meeting with me to discuss the topic, identify core concepts and collect background information
- Circulate one non-technical lead article to the class one week prior to your presentation
- Prepare a one page cover sheet with your reading list and reference citations
- Give a 10 min presentation and lead a 10 min class discussion covering the topic, providing background, chemistry and core course concepts, and introducing the socio-economic context

Possible sources of information

- Textbooks, Associations and Journals
- Government publications & websites
- Science news journals [Science News](#) [Science Daily](#) [Canada.com](#)

Useful Links: [American Chemical Society News Releases](#)
[Chemistry World](#)
[Environment Canada](#)
[Health Canada](#)
[US EPA](#) (Environmental Protection Agency)
[NOAA](#) (National Oceanic and Atmospheric Administration)

Use search terms: *air pollution, air quality, atmospheric chemistry*

Grading:

- | | |
|-------------------------------------|----|
| Organization, Clarity, and Research | /3 |
| Chemistry Content and Context | /3 |
| Discussion & Societal Impact | /4 |

Suggested Case Study Topics:

1. How cars could meet future emission standards
2. Selecting the right house plants could improve indoor air
3. Storing carbon dioxide underground by turning it into rock
4. Lifting the fog on China's unwieldy air pollution problem
5. Scientists partner with Google Earth Outreach to analyze methane leaks in US cities
6. Stratospheric dichloromethane could delay ozone recovery by decades
7. Climate change poised to push up mercury in food chain
8. Sources and legislative control of PM 2.5 pollution
9. Air pollution health: knowledge gained from Umea, London and Beijing
10. Do diesel vehicles cause poor air quality?
11. Air pollution and traffic: Searching for the missing emissions
12. Air quality advisory issued for MetroVancouver and Fraser Valley
13. Air pollution more deadly in Africa than malnutrition or dirty water
14. UK citizens are taking air pollution monitoring into their own hands
15. How to measure potentially damaging free radicals in cigarette smoke
16. During heat waves, urban trees can increase ground level ozone
17. Keeping cool in summer leads to increased air pollution
18. Indoor air in schools could add to children's exposure to PCBs
19. Radon gas policy challenge for Canada
20. Learning to love CO₂
21. City air
22. Subway air pollution damages passenger health
23. Air pollution model predicts 6.6 million deaths by 2050
24. NASA show human impact on atmosphere with pollution maps
25. Hungry ghost festival behind air quality decline in Singapore
26. Canada to match US on curbing HFCs
27. UK citizens taking air pollution monitoring into their own hands
28. Air pollution deadlier than malnutrition or dirty water in Africa
29. Carbon dioxide-to-methanol catalyst ignites 'fuel from air' debate
30. Water nanostructures disinfect air
31. Smog eating paint does more harm than good
32. Looking for methane leaks

Possible Guest Speakers:

Dr. Julie Saxton, P.Chem., Air Quality Specialist, MetroVancouver
Air Quality in the Fraser Valley

Dr. Corinne Schiller, Air Quality, Environment Canada
Near Road Study in an Urban Environment

Dr. Nick Davey, Chemistry, Applied Environmental Research Labs
Mobile Mass Spectrometry and VOC Mapping

