

Atmospheric Chemistry Syllabus

Department of Physics and Atmospheric Science

PHYC/OCEA/CHEM 4595 Fall 2024

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Ian Folkins	ian.folkins@dal.ca	Please contact

Course Description

A fundamental introduction to the physical and chemical processes determining the composition of the atmosphere and its implications for climate, ecosystems, and human welfare. Origin of the atmosphere. Nitrogen, oxygen, carbon, sulfur cycles. Climate and the greenhouse effect. Atmospheric transport and turbulence. Stratospheric ozone. Oxidizing power of the atmosphere. Regional air pollution: aerosols, smog, acid rain.

Course Prerequisites

MATH 1000.03, PHYC 1190.03/1290.03 (or PHYC 1310.03/1320.03 or 1300.06) and CHEM 1011.03/1012.03

Course Exclusions

PHYC 5595.03, OCEA 5595.03

Student Resources The main resource that will be used is the class web page at <https://www.mathstat.dal.ca/~folkins/chemistry.html>. This is where assignments, old quiz and exam questions, and other additional resources, will be posted.

Course Structure

Course Delivery: The method of delivery will be exclusively in person. Classes are not recorded.

Lectures: MWF 12:35 - 1:25, Dunn 302

Laboratories: Not applicable.

Tutorials: Available before quizzes as requested.

Course Materials

The text is Atmospheric Chemistry, by Daniel Jacob. This book is available online here: <https://acmg.seas.harvard.edu/education>. We will be using the original 1999 edition, which is freely available. Also please see the class web site listed above.

Assessment

Assignments: There will be 8 assignments. There will typically be assigned during the weeks when there is not a quiz. They are given in the class web page. They are worth 20% of the final grade.

Tests/quizzes: There will be three quizzes, each of which contributes to 10% of the final grade. They are in class, and will likely be held during lectures 11, 22, and 33. The specific material to be covered will be listed in the class web site several days before each web site but will not differ substantially from what is currently given on the class web site.

Final exam: The Final Exam will be 50% of the final grade. It will be held during the exam period. The date will likely be determined by class discussion.

Other course requirements: Not applicable

Conversion of numerical grades to final letter grades follows the

[Dalhousie Grade Scale](#)

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies on Missed or Late Academic Requirements

Students should email in advance if they are not able to hand in an assignment on time, or attend a quiz or exam, so that alternate arrangements can be made. Students will not ordinarily receive any credit for a class component that is not completed. Class assignments that are late will ordinarily lose 10 percent of their value per day.

Students must use the Student Declaration of Absence form for missed academic requirement in this course (except for the final exam). They may use this form three times.

Course Policies related to Academic Integrity

Students are welcome to discuss assignments with each other but must solve them on their own.

Learning Objectives

1. Calculating reaction rates and learning to manipulate number density, mixing ratio, and column amounts.
2. Using simple box models to solve atmospheric chemistry problems.
3. Having a conceptual understanding of radiative propagation and how photolysis rates are calculated.
4. Understanding the chemical evolution of the earth and the geochemical cycling of nitrogen, carbon, and oxygen.
5. Understanding the sources and scattering properties of aerosols.
6. Calculating the ozone profile using simple Chapman ozone chemistry and calculating the effects on ozone of other catalytic cycles.
7. Understanding the physical chemistry of polar stratospheric clouds and how they contribute to enhanced polar ozone depletion.
8. Understanding the chemistry of the hydroxyl radical, and how it is affected by tropospheric ozone, NO_x, and hydrocarbons.
9. Understanding the origins of enhanced ozone production in cities, and regional air pollution.
10. Understanding the chemistry of NO_x and SO₂ and how they contribute to acid rain.

Course Content

The course material will consist of Chapters 1 - 13 from the text. We do not do all parts of each Chapter. The class web page specifies the book slides that are required course material for each chapter. There is a strong emphasis on box models and family approaches, as these are usually the only methods in which problems in atmospheric chemistry can be solved analytically. The first 10 lectures typically discuss the basics of the atmospheric origin and current composition and structure, and the carbon and nitrogen cycles. The second part of the course (lectures 12 - 21) discusses stratospheric ozone chemistry, the Chapman expression for the ozone layer, ozone depletion, aerosols, photolysis, and the basics of atmospheric radiative transfer. The third part of the course (lectures 23 - 36) discusses tropospheric ozone chemistry, smog, and acid rain.

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:

https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: <https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html>

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.