EPS 133/ESE 133: Atmospheric Chemistry – Spring 2024

Prof. Daniel J. Jacob (djacob@fas..harvard.edu, office Pierce 110C)

TFs: Laura Yang (laurayang@g.harvard.edu) and Lucas Estrada (lestrada@g.harvard.edu)

Course description: An introduction to the chemical and physical processes determining the composition of the atmosphere and the implications for climate, air pollution, and life on Earth. Atmospheric structure, simple models, atmospheric transport. Nitrogen, oxygen, carbon, mercury cycles. Chemical forcing of climate change. Stratospheric ozone. Atmospheric oxidants. Air pollution. Acid rain. Emphasis is on the construction of simple models and the application of chemical principles to understand and address current environmental issues.

Prerequisites: Physical Sciences 11, Mathematics 1b, or equivalents.

Schedule: Lectures WF 10:30-11:45am. Weekly 1-hour section to be arranged. No lectures during reading period.

Text: Introduction to Atmospheric Chemistry, by D. J. Jacob, 2nd edition. Available online from Jacob's website (go to the Education page). Password to open the files is 'atmchem'. Password to print and edit the files is 'Bw03575!'. Please do not share these passwords and keep them out of cyberspace.

Assignments:

1. Weekly homeworks, 50%. Homeworks will be assigned on Wednesday, due the following Wednesday, and returned Friday. Late homeworks will not be accepted. Your lowest grade of the semester (or a missing homework) will be dropped when computing the grade average. You are encouraged to work collaboratively but must write the solutions alone. Access to others' solutions, is strictly prohibited.
2. Midterm presentation, 10%. A critical review of the research literature on a topic of your choice, based on material covered so far in class, with 7-minute oral presentation to the class. This will be scheduled during section time. There will be no homework that week.
3. Presentation at end of semester, 20%. A critical review of the literature on a relevant topic of your choice, different from the midterm presentation, with 12-minute oral presentation to the class. This will be scheduled during reading/exam period.
4. Answers to pre-lecture questions, 10%. You won't be graded on whether you're right or wrong but on having thought through the questions with your student group.
5. Participation in lectures and sections, 5%. You are expected to be an active participant in lecture, in section, and/or during office hours by asking questions, offering comments, etc.
6. Ice-breaker meeting, 5%. Email Prof. Jacob to schedule a 5-minute meeting in the first two weeks of the course so that he can get to know you a bit, your background, motivations for taking the class, any concerns, etc. Meetings will normally be in his office (Pierce 110C).

Office hours: Jacob: after class and by appointment. TFs: to be determined according to students' schedules. E-mail is an excellent way to schedule an appointment, ask questions, etc. A prompt reply is guaranteed.

Schedule of lectures

1/24	Course organization, measures of atmospheric composition
1/26	Water in the atmosphere
1/31	Vertical structure of the atmosphere
2/2	Atmospheric lifetime, simple models
2/7	General circulation of the atmosphere
2/9	Vertical motions and stability
2/14	Geochemical cycling, nitrogen cycle
2/16	Oxygen cycle
2/21	Carbon chemistry in the ocean
2/23	Carbon cycle
2/28	Blackbody radiation
3/1	Greenhouse effect
3/6	Aerosol effects on climate
3/8	Radiative forcing of climate change
3/13	spring break
3/15	spring break
3/20	Chemical kinetics, stratospheric ozone
3/22	Catalytic cycles for stratospheric ozone loss
3/27	The ozone hole
3/29	Tropospheric oxidant chemistry
4/3	Tropospheric ozone
4/5	Ozone pollution
4/10	Aerosol pollution
4/12	Acid rain
4/17	Organic aerosols
4/19	Mercury
4/24	Methane