



Department of
Chemistry
Illinois State University

Course Syllabus

Atmospheric Chemistry
(CHE 380.59)

3 hours

Department of Chemistry
Illinois State University



your element

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Office Hours: Mon. and Tue. 11 – 12 or by appointment.

Course Overview:

This course introduces the student to the field of atmospheric chemistry. Students will first learn basic concepts such as the structure and composition of the atmosphere. They will then use these concepts to study processes such as cyclic processes, photochemistry, ozone chemistry and ionic chemistry in the atmosphere. Finally, if time permits, the Earth's atmospheric chemistry will be compared with other planets and moons in our, and other, solar systems.

Student Objectives:

Students completing this course will...

1. understand the basic physical and chemical structure of the earth's atmosphere,
2. understand the cyclic behavior of carbon, oxygen, nitrogen and sulfur in the atmosphere,
3. use these properties to study and understand deviations from the norm such as ozone depletion and the greenhouse effect,
4. be able to understand the fundamental differences between the earth's and other planetary atmospheres.

Approximate order of material

- 1.) Chemical composition: a preliminary survey
 - (a) Earth's atmosphere in perspective
 - (b) Particles, aerosols, and clouds
 - (c) Ozone
 - (d) Cyclic processes
- 2.) Atmospheric behavior as interpreted by physics
 - (a) Pressures
 - (b) Radiative heating
 - (c) Temperature profiles
 - (d) Winds
 - (e) Condensation and nucleation
 - (f) Light Scattering
- 3.) Photochemistry and kinetics applied to atmospheres
 - (a) Photochemical change

- (b) Photochemical primary processes
 - (c) Adiabatic processes and the correlation rules
 - (d) Chemical kinetics
 - (e) Multistep reaction schemes
 - (f) Models of atmospheric chemistry
- 4.) Ozone in Earth's stratosphere
- (a) Oxygen-only chemistry
 - (b) Influence of trace constituents
 - (c) Perturbations of the stratosphere
 - (d) Anthropogenic impact on the stratosphere
 - (e) Polar ozone holes
 - (f) Ozone variations and trends
- 5.) The Earth's troposphere
- (a) Sources, sinks, and transport
 - (b) Oxidation and transformation
 - (c) Biogenic volatile organic compounds
 - (d) Aromatic compounds
 - (e) Compounds of sulphur
 - (f) Natural halogen-containing species
 - (g) Heterogeneous processes and cloud chemistry
 - (h) Models, observations, and comparisons
 - (i) Air pollution
- 6.) Ions in the atmosphere (optional)
- (a) Electrical charges in the atmosphere
 - (b) Ion chemistry in the atmosphere
 - (c) Ionization mechanisms
 - (d) Ions in the stratosphere and troposphere
- 7.) The airglow (optional)
- (a) Optical emission from planetary atmospheres
 - (b) Excitation mechanisms
 - (c) Airglow intensities and altitude profiles
 - (d) Specific emission sources
- 8.) Extraterrestrial atmospheres
- (a) Venus
 - (b) Mars
 - (c) Jupiter and Saturn
 - 1. Titan, Io, Europa, and Callisto
 - (d) Uranus, Neptune, Triton, and Pluto
 - (e) Extrasolar planets
 - (f) Comets
- 9.) Evolution and change in atmospheres and climates (optional)
- (a) Source of atmospheric constituents
 - (b) Noble gases and nitrogen in planetary atmospheres
 - (c) Isotopic enrichment
 - (d) Evolution of Earth's atmosphere
 - (e) Climates in the past
 - (f) Climates of the future

Readings:

Required Text

1. Richard P. Wayne "Chemistry of Atmospheres" Oxford University Press Inc., New York, NY 2000 ISBN 0-19-850375 X (Pbk)

Optional Text

1. P. Atkins "Physical Chemistry" 6th Edition, W.H. Freeman and Company, New York, 1998

Required Student Tasks/assignments:

The course will consist of regular lectures, homework sets, exams and a project. The homework sets will be made up of problems culled from both the text and lecture notes. All problems will highlight a particularly important aspect of the material covered.

Evaluation

Achievement in the course is measured with homework assignments, projects, quizzes, and exams:

Letter grades will be assigned based on either a straight scale or a curve to be determined before class starts.

GRADING SCALE

There will be a total of approximately 800 points possible over the course of the semester. Grades will be assigned on a percentage basis that will vary depending on whether you are an undergraduate or graduate student.

For undergraduate students it is: A 90-100%, B 80-89%, C 70-79%, D 60-69%, and F 59% and below.

Since graduate students are expected to perform at a higher level the grading scale is more difficult: A 93-100%, B 83-92%, C 73-82%, D 63-72%, and F 62% and below.

Students are encouraged to stop by during office hours if they would like to see how they are doing in class.

Exam/Homework Structure Note: Exact dates/times will vary each semester

Homework/Quiz

Course website goes live.

First homework assignment posted online.

Quiz #1 posted online.

Second homework assignment posted online.

Quiz #2 posted online.

Third homework assignment posted online.

Quiz #3 posted online.

Fourth homework assignment posted online.

Quiz #4 posted online.