ATM SCI 110: Origin, composition and structure of planetary atmospheres
Online

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Office hours: 2 hrs per week or by appointment

Prerequisites: None

Course Description: This one-term course is intended for prospective elementary school teachers, students majoring in business and engineering, the life and social sciences, and liberal arts. A brief introduction to the origin of the solar system, its planets and planetary atmospheres is followed by a more detailed qualitative discussion of the physical principles and behaviors of the Earth's atmosphere, as well as its history. Known properties and inferred histories of the planetary atmospheres are then compared to those of the Earth's atmosphere. The course introduces various elements of scientific discovery and analysis method and applies them to illustrate the uniqueness, preciousness and fragility of climate and life on our home planet.

Module summaries (**tentative COMPLETION dates are given in parentheses**):

0. (**01/28**) Course Introduction.

I. (**02/04**) Origin of the Solar System. The sun. Orbital characteristics of planets. Composition of the planets and their atmospheres. Evolution of planetary atmospheres.

II. (**02/11**) Composition and mean structure of the Earth's atmosphere; weather and weather elements. Heat transfer processes.

III. (**02/18**) Energy balance of the Earth. Greenhouse effect. Diurnal and seasonal cycles. Regional variations of temperature.

IV. (**02/25**) Water in the Earth's atmosphere, fog and clouds. Cloud formation and precipitation.

V. (**03/04**) Winds and their causes. Global circulation systems and evaporation/ precipitation patterns. Middle latitude storms and weather.

VI. (**03/11**) Observations of planetary atmospheres. Proxy climate records: How do we infer climates of the past? Instrumental records: *In situ* measurements and remote sensing. Space missions.

VII. (**03/18**) Climate variability. History of climate change on Earth. Changing chemistry of the air on Earth. Anthropogenic effects on the state of the atmosphere.

VIII. (**04/01**) Venusian atmosphere: Composition and greenhouse effect, clouds. Weather on Venus. Atmospheric evolution: Why are Venus and Earth so different?

IX. (**04/08**) Vertical structure of the atmosphere on Mars. Daily and seasonal temperature variations. Martian weather. Dust storms. History of the Martian atmosphere. Comparing Earth, Venus and Mars.

X. (**04/15**) Jupiter and Saturn: Vertical structure of the atmosphere. Clouds, colors and chemistry. Zonal jets. Great Red Spot.

XI. (**04/22**) Uranus and Neptune: planets on the outskirts of the Solar System.

XII: (**04/29**) Titan: A satellite with an atmosphere.

Final Project (**04/30 – 05/19—last day to turn in!!!**): Comparative climatology of the Solar System's planets.

Delivery and Attendance: **This course is entirely self-paced!** There are 12 modules in the course. Each module consists of PDF files of slides with notes, along with supplementary links to local and external webpages. Attendance/time spent working on the material will not be part of the grading. However, your progress will be monitored, and a friendly email reminder will be provided if you are not making progress consistent with completing the course by the end of the term! **Please pay attention to tentative completion dates for each module, as given in the schedule above!**

Grading and instructor's feedback: Module quizzes 70%; module discussion forums 10% of the grade, final project 20% of the grade. Each module has a **10-question multiple-choice quiz** and a discussion forum, with a possibility of bonus points for each discussion. You will be allowed to take each module's 6-minute quiz unlimited number of times (**with a minimum 1-hour interval between attempts — this will be strictly enforced! [You will lose 50% of your final quiz grade if you violate this requirement]**) until you earn the quiz score of **80% or higher**. The questions for each quiz attempt will be randomly drawn from the corresponding question bank, which has many more questions than the 10 on an individual quiz, and the order of multiple-choice answers within each question will also be

randomized. Correct answers will not be provided until after the final attempt, only the final score. **You won't be able to advance to the next module without passing the current module's quiz.** I will monitor your quiz attempts and will provide personalized feedback after the third attempt to help focus your preparation for the next quiz attempt.

In each module's **discussion forum**, you will be asked to post a comment about the topic we have covered in this module, which you are most unclear about and *describe in a few words* the essence of your confusion. This discussion item is graded on a 0–1–2 scale. 0: no participation (this is also equivalent to just posting a topic name, e.g., "I am unclear about cloud formation"); 1: post lists a particular topic, but the discussion is weakly argued; 2: the post is relevant, discussion is logically sound and clear. Up to 1 (one) additional **bonus** point will be added for a high-level comment relevant to the course material. You can post your own comment **OR** respond to the previous comment by someone else. The "yes," "no," "I agree" and the like responses will not count toward participation. Your comment has to contain at least 250 characters. I will provide general feedback about the salient points of the discussion after the majority of the students in class had a chance to submit their posts.

In the **final project**, you will be asked to synthesize the information you've learned and mastered throughout the course. Detailed instructions and rubric will be provided on the course website after you will have completed the main module sequence.

The semester grade will be determined as the percentage of maximum possible points earned for quizzes and discussions. This percentage will be given by D2L on an ongoing basis. **Grading Scale**: Minimum cutoffs

A	A–	B+	B	B–	C+	C	C–	D–	F
93	90	88	83	80	78	73	70	60	<60

Text: None required.

If a student would like more background (particularly for the modules II–VI), a good text is *Essentials of Meteorology* by C. Donald Ahrens. This text is a standard text in introductory meteorology courses, and older editions can be had for less that $10 on Amazon.com.

A vivid introduction to the atmospheric chemistry and the problem of climate change can be found in *Atmospheres, Climate, and Change* by T. E. Graedel and P. J. Crutzen.

The New Solar System edited by J. K. Beatty, B. O'Leary and A. Chaikin provides a lucid summary of the first two decades of space exploration and discusses a broad variety of planetary science topics.

Another great book the course has a lot of material from is "*The Planetary System*" by D. Morrison and T. Owen.

Planetary Atmospheres by F. W. Taylor is an up-to-date introductory text on the subject. It is designed for upper-level undergraduate courses and is structured accordingly.

A relatively new book: *Planetary Climates* by A. P. Ingersoll is an original account of planetary atmospheres.

SUPPLEMENTAL INFORMATION

Time Investment. The amount of time that an average student should expect to spend on this class is as follows:

- Time spent studying modules, including the final project: 45 hours
- Time spent exploring supplemental material: 30 hours
- Time spent completing quizzes: 30 hours
- Time spent commenting/reading discussion boards: 15 hours
- Time spent reviewing module material after initial quiz attempts: 24 hours

Total time spent on this class: 144 hours

Important Dates:

Last day to add or change credit status	02/02
Last day to drop without a "W" on record	02/16
Last day to drop or withdraw	03/18

Disability: Students with special needs have access to educational opportunities equal to those of non-special need students. To ensure that reasonable accommodations can be made for students with special needs each student must identify him- or herself in a timely manner, preferably prior to the beginning of a term. However, if students are unsure of eligibility to receive accommodations and have not discussed this with a university representative, students should discuss these concerns with their instructor or advisor as early as possible.

Religious Observances: Students will be allowed to complete examinations or other requirements that are missed because of a religious observance.

Academic Misconduct: The University has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion of and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. Further information may be found at http://uwm.edu/academicaffairs/facultystaff/policies/academic-misconduct/

Complaint Procedures: Students may direct complaints to the head of the academic unit or department in which the complaint occurs. If the complaint allegedly violates a stated university policy, it may be directed to the head of the department or academic unit in which the complaint occurred or to the appropriate university office responsible for enforcing the policy.

Grade appeals: A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow the established procedures adopted by the department, college, or school in which the course resides. These procedures are available in writing from the department chairperson or Academic Dean.

Sexual Harassment: Sexual harassment is reprehensible and will not be tolerated by the University. It subverts the mission of the University and threatens the careers, educational experience, and well being of students, faculty, and staff. The University will not tolerate behavior between or among members of the University community that creates an unacceptable working environment. Further information can be found at: https://uwm.edu/titleix/get-help/