Class Syllabus SPACE 103/ASTRO183
The Perils of Space:
An Introduction to Space Weather

Instructor:	Prof. Mark Moldwin
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Class Location:	1650 Chemistry Bldg (Central Campus)
Class Time:	Tuesday and Thursday 10 – 11:30am

Student Hours (aka Office Hours): In-person Tues and Thurs 9-9:50am (before class) Michigan League Coffee Shop; in-person CSRB1418 or virtual scheduled through Google Calendar Appointments. Please let me know if these times do not work so we can schedule other dates and times.

Required Texts:

> *An Introduction to Space Weather, 2nd Edition*, Mark B. Moldwin, Cambridge University Press, Cambridge UK, 2023 (Note Available through UM Library electronically).

Goal of Class:

> "Space weather" is an emerging domain of the space sciences that studies the conditions in space that impact society its technological systems. Space weather is a consequence of the behavior of the sun, the nature of Earth's magnetic field and atmosphere, and our location in the solar system. This 3-credit class is a lower-division introduction to space weather for all majors. The basics of the solar-terrestrial relationship will be introduced and introductory physics describing the interaction will be explored. The goal of the course will be to assist you in understanding the physical processes that connect the variable sun to the Earth through an exploration of the societal impacts of Space Weather. In addition, we will explore research on learning to explain the teaching methodology used in the course and help you in your classwork. One objective is to have you improve your critical thinking skills – to be able to identify assumptions, test hypothesis and draw relationships between variables.

Learning Objectives : After completing this course you will be able to describe the fundamental concepts of space weather, do some calculations and experiments relevant for space weather, and learn about learning to help you in this and all of your courses.

Style/Format of Class

The class will consist of mini-lectures interspersed with small group discussions and activities. My philosophy is that it is hard to learn if you don't think, so I'll provide many opportunities for everyone to think aloud and discuss topics and solve problems with your classmates. Though there is no formal lab component to the class, it is always good to "do science" and just not hear or read about it. Therefore I have developed a number of Dorm Room Lab Experiments that will be given to everyone throughout the semester. These are hands-on fun activities directly connected to the content of the course and are part of your HW/Quiz/Lab grade. Though the class is geared to non-science majors, you WILL need to devote time and intellectual effort to the class. **Class attendance** is an important part of learning and therefore is strongly encouraged and supported by providing ample classroom learning opportunities and you can earn extra participation points. Please send an email prior to class for any excused absences.

Outline of Class (DRAFT Subject to Change)

a. Week 1 (Aug 29; Aug 31): Overview of Space Weather (What it is and how it impacts your life). Some essential physics will be introduced (E&M, concept of plasma and followed up where appropriate throughout). Overview of Learning Theory (What it is and how it can greatly impact your life).

b. Week 2 (Sept 5, 7): The Dynamic Sun (Structure of the Sun, description of solar processes, the origin of the solar wind – thermodynamics, gravity, magnetic fields). Active reading (method to efficiently learn from reading technical writing).

c. Week 3 (Sept 12, 14): The solar wind (the structure and radial variability of the heliosphere, interplanetary magnetic field – conservation laws, spiral nature of IMF). Concept Mapping (a graphical conceptual strategy to understand and connect).

d. Week 4 (Sept 19, 21): The Earth's Magnetosphere (Structure and dynamics of the Earth's space environment – shocks, pressure equilibrium, reconnection). Study skills (most students use study methods that are proven to be ineffective. Why? What are proven effective strategies?)

e. Week 5 (Sept 26, 28): The Earth's upper atmosphere and Ionosphere (aurora, photochemical processes, convection)

f. Week 6 (Oct 3, 5): Group Study Session and MIDTERM

g. Week 7(Oct 10, 12) and 8 (Fall Break, Oct 20): Concept of Space Weather; Geomagnetic storms and substorms; Technological and Societal Impacts of Space Weather (Satellites, communication, power grids); Case Study

h. Week 9 (Oct 24, 26) and 10 (Oct 31, Nov 2): Living in Space: (overview of manned space flight issues, radiation)

i. Week 11 (Nov 7, 9). Space Weather Forecasting: (overview of modeling)

j. Week 12 (Nov 14, 16) and 13 (Nov 21, Thanksgiving Break): Satellite design considerations for robotic and human space space exploration; Metacognition

k. Week 14 (Nov 28, Nov 30): Space Weather Mission Overview, Group Study Session

l. Week 15 (Dec 5, 7): Astrobiology; What is the Worst that can Happen? Examination of Space Weather impacts on society, Study Skills

m. **Take Home** FINAL EXAM: Due Sunday December 10 at 3:30pm

Weekly Assignments: Every Thursday an assignment is due or an in-class quiz or mid-term will be given. Every Monday at midnight, a short multi-choice reading quiz is due via Canvas beginning in Week 2 (September 4). NOTE there is a "no-excuse needed 24-hour grace period" for ALL assignments. If you need additional time beyond the grace period, please contact me prior to the due date if possible.

Reading Assignments: It is expected that each student come prepared to class by reading the text **prior** to coverage in class. A reading assignment and short on-line Canvas Reading Quiz is given each week to reward that effort.

Grades:

Your final grade will be based on the following components:

55% weekly quizzes, dorm-room lab, HW
20% mid-term
25% Final Exam
Bonus Points: up to 4% Participation Bonus Points

Quizzes/Labs/HW: There will both in class quizzes and on-line Canvas reading quizzes given each week. The short reading quiz will cover major conceptual material

in the assigned reading while the in-class quizzes will include some problem solving and conceptual questions. I'll drop the lowest weekly score in this assignment category.

Mid-term: There will be one mid-term. It will contain short answer questions based on the readings and lectures.

Final Exam: The take home final exam will be comprehensive and be a combination of the same format as the mid-term and a short research essay.

Bonus Points: Up to 4 extra credit points can be earned. 1 point by attending office hours. 1 point for attending a planetarium show or seminar or event that are advertised regularly in class and on CANVAS.

Accessibility and Accommodations

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, such as the assignments, in-class activities, or the way we teach may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with you, the Office of Services for Students with Disabilities, or the Adaptive Technologies Computing Site to help determine appropriate accommodations. We will treat any information about your disability with the utmost discretion.

Student Mental Health and Well-being

University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact **Counseling and Psychological Services (CAPS)** at (734) 764-8312 and https://caps.umich.edu/ during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult **University Health Service (UHS)** at (734) 764-8320 and https://www.uhs.umich.edu/mentalhealthsvcs, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresources. For a listing of other mental health resources available on and off campus, visit: http://umich.edu/~mhealth/.

Attendance, Participation, and Universal Learning

Attendance and participation are highly important for learning and engagement. If you must be absent because of an emergency or illness, please make every effort to speak or email with me about it beforehand, if possible, or after the next class. I will excuse such absences. Please notify me of absences due to religious observance or University sporting events as soon as you can, or by the *third week of the semester*. Keep in mind that more significant number of unexcused absences has been shown to impact your final grade.

I am committed to the principle of universal learning. This means that our classroom, our virtual spaces, and our interactions be as inclusive as possible. Mutual respect, civility,

and the ability to listen and observe others carefully are crucial to universal learning. Active, thoughtful, and respectful participation in all aspects of the course will make our time together as productive and engaging as possible.

Your success in this class is important to me. If there are circumstances that may affect your performance in this class, please let me know as soon as possible so that we can work together to develop strategies for adapting assignments to meet both your needs and the requirements of the course.

Title IX Statement

Title IX makes it clear that violence and harassment based on sex and gender is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here:

- UM Sexual Assault and Prevention Center (SAPAC) 24-hour confidential crisis line (734) 936-3333 * http://sapac.umich.edu/
- UM Counseling and Psychological Services (CAPS) (734) 764-8312 * http://caps.umich.edu/
- University of Michigan Police (DPSS) (734) 763-1131 (or 911 for emergency) * http://www.dpss.umich.edu/
- UM Office of Student Conflict Resolution (724) 936-6308 * http://oscr.umich.edu
- UM Newnan Academic Advising Center (734) 764-0332 * https://lsa.umich.edu/advising

Because of my role as a Faculty Advisor, I am obligated by the Cleary Act to report incidents. This report goes to the University and does not need to include names or be forwarded to the police. See above for confidential resources.

Plagiarism

The LSA Office of Academic Affairs defines plagiarism as "representing someone else's ideas, words, statements or other work as one's own without proper acknowledgment or citation" (see http://www.lsa.umich.edu/academicintegrity/examples.html). New writing challenges can tax your writing fluency, and entering new academic areas can test your abilities to synthesize and take ownership over source texts and concepts. My goal as instructor in this course is to help you through these obstacles so that you can find your footing as a writer in a technical area. Your objective as a student is to be confident, seek help, persevere, and work through these new areas of knowledge and skill development until you begin see your growth. This work requires patience, planning, and focus.

Much plagiarism occurs as a result of a lack of care in regard to reading, note taking, and citation practices, or from procrastination, and/or panic. Care, timeliness, and communication will eliminate most of the risk. If you have questions about whether you

should give credit to a source in your work, you may clarify it with me. In general, though, I always recommend the citing sources you have consulted as well as those you borrow from directly. With the advent of Chat-GPT and Bing, there is extreme temptation to have AI bots do the hard work of understanding and communicating your understanding. If you use AI assistance in your final report writing, please acknowledge how you used it and cite the work (e.g., it should be clear what you wrote and what was written by a bot). I will have a few ChatGPT assignments to help us understand the strengths and weaknesses in using them for technical formulation.

Honor Code and Classroom Rules

Please conduct yourself ethically and responsibly. Please read the UM Honor Code. Copying of assignments, submitting work of others as your own, violating exam rules, and turning in assignments late will not be tolerated. See http://www.crlt.umich.edu/faculty/honor.php for the code appropriate for your discipline/college/school.

I will be using non-electronic learning technology in the classroom this semester. Please turn off cell-phones and **DO NOT** open up laptops. I've found that they are a distraction to both the student with the laptop and to those around them. ***If you use laptops to take notes***, please sit in front and to the side.

Email, CANVAS and Student Hours/Office Visits

I will regularly send you course announcements, reading assignments, and articles of interest through the Canvas Site. Please feel free to email any individual questions you may have directly to me HOWEVER use the discussion board on the CANVAS site for course logistics, quiz, Mini-exams, project, and reading type questions. Please visit in person or virtual student hours regularly. Student Hours (aka Office Hours) are really not for those seeking assistance in the class, but really to help me learn more about your goals and understanding so I can better facilitate your learning.