ASEN 5016
SPACE LIFE SCIENCES

Spring 2026

Tues/Thurs 10:00m-11:15am MT
AERO 111

Instructor: Dr. Prachi Dutta

Course TAs: Amrita Singh

Classroom Recordings:
Available via Canvas under Spring 2026 Lecture Videos

We will use Canvas' Discussions board for online discussions related to the technical material of the course. I ask that you post your questions related to course material there, such that other students can review and answer, as well as the instruction team. It is likely that your question may also be a question that other students are having, so posting to Canvas will facilitate availability to everyone. If you have non-technical questions that only relate to yourself, you may email myself and our TA (as appropriate) with the subject line "ASEN 5016: ___".

This course is intended to familiarize engineering students with factors affecting living organisms (ranging from single cells to humans) in the reduced-gravity and increased radiation environment of space flight from orbital freefall to lunar and Martian surface conditions. Unique insight will be gained regarding engineering design requirements for spacecraft habitats, life support systems, spacesuits, and space biology payloads. Life support system drivers, as they relate to basic human survival requirements, are covered initially. Next, the lectures turn to more detailed descriptions of the physiological adaptations that occur to people in space, with pertinent background information presented for each topic. Corresponding biomedical countermeasures used to maintain crew health for long duration missions will also be discussed. Finally, the underlying biophysical mechanisms affected by gravity, along with experiment design criteria, will be addressed. Current events within NASA's research and exploration mission programs and the emerging commercial human space flight sector are reflected throughout the lecture topics.

To further elaborate on the lecture material discussed in class, a series of integrated homework tasks provides a practical introduction to the process of journal article publishing and research proposal writing, including the anonymous peer review process used for each. The assignment involves writing a short journal article on an approved topic of your choice, your participation as a peer reviewer for the editor, revising your draft per the review comments you receive back, and resubmitting a final manuscript with a corresponding summary of changes made. From this background, you will subsequently prepare a research grant proposal that builds on your selected topic (along with a CV and budget), again goes through peer review, and culminates in a mock review panel. This end-to-end flow closely mimics the standard practice used in the scientific community and is a valuable generic process to experience regardless of your specific research interests.

GRADING **50% - Online Unit Quizzes, Best 5 of 6, 10% each**

Will occur roughly every 2 weeks and you will have a week to complete each online, around your own scheduling constraints.

As we will drop your lowest Unit Quiz and you have a 1-week window to complete, there will be no make-ups

20% - Homework 1, Review Article – *grade based on final 'revised and resubmitted' version following peer review*
5% - Homework 2, Journal Peer Review – *your evaluation effort as a reviewer*
20% - Homework 3, Research Proposal – *grade based on proposal submittal with consideration of reviewer comments*
5% - Homework 4, Proposal Peer Review – *your evaluation as a reviewer and participation in the 'Mock Panel Meeting'*

All late homework will receive an automatic 10% penalty with a 5% penalty for each additional 24 hr period in which the assignment is late. No exceptions regardless of circumstances.

TEXT *Space Physiology*, Buckey, Oxford University Press, 2006 (required)

Topic-relevant journal articles will also be provided on Canvas throughout the semester

Interesting ancillary/old references for related info on this field of study (<u>not</u> required)

Textbook of Medical Physiology, 12th ed. Guyton and Hall, 2011(& newer)

Fundamentals of Aerospace Medicine, 4th ed., Dehart and Davis, 2008 (& newer)

Going Higher – Oxygen, Man and Mountains, 5th ed., Houston, 2005 (*& newer)*

Fundamentals of Space Medicine, Clement, Kluwer Academic Press, 2003

Medicine for Mountaineering – general title, various options

Space Physiology and Medicine, 3rd ed., Nicogossian, Huntoon and Pool, 1994 (out of print, difficult to find)

Bioastronautics Data Book, 2nd ed., Parker and West (eds.), NASA SP-3006, 1973 (1st ed., Webb, 1964, both are out of print, difficult to find)

ASEN 5016 LECTURE TOPICS and REQUIRED READINGS
Note: O*rder and topics subject to minor revision depending on the speed of lecture progression, guest lectures, and deviations in course material depending on student interest. I try to adapt graduate level classes to discuss topics that are of interest to the students based on questions you ask. Please anticipate completing the readings prior to class*.

Overview of Humans in Space
(January through early February)

Course Overview & Historical Perspectives on Human Space Flight
Relevant Space Flight Environmental Parameters
Human Spacecraft Life Support Requirements and Considerations
Gravity-Dependent Physical Processes
Respiration and the Oxygen Cascade
Nutrition – Ch. 8 & Temperature Regulation
Motor Control & Chronobiology

Human Physiological Adaptations to Space Flight
(February through March)

Human Performance Factors
Miscellaneous Physiological Responses to Space
Neuro-Sensory System – Ch. 6 (*balance*) & Ch. 9 (*space motion sickness*)
Hormonal Regulation / Immunological Response
Cardiovascular System – Ch. 7
Muscular System – Ch. 4
Skeletal System – Ch. 1
Physiology of Extravehicular Activity (EVA) – Ch. 5

Space Biology Experiment Design & Proposal Writing

The week of March 16-20th is spring break and we will not have lectures during this week.

Space Life Science Research
(April)

Biomedical Countermeasures – Ch. 11 & 12 (partial)
Radiation Effects – Ch. 3
0g & 1g Analogs (Earth-based and Space-based)
Microbial Responses, Biotechnology & Related Crew Health Issues
Plant and Animal Research in Space
Operational Space Medicine – Ch. 12 (partial)
Psycho-Sociological Aspects – Ch. 2
Astrobiology / Mock Review Panel prep
Course wrap up

Mock Proposal Review Panel – Final Exam Period

Monday *April 27, 2026 from 1:30 pm – 4:00 pm*

Aerospace Engineering Sciences & University Policies

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Students should expect to receive accommodations for a timed assessment (e.g., exam) only if your faculty instructor(s) receives the student's

accommodations letter at least 5 business days before the assessment, as a departmental policy, in order to facilitate administering the assessment. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.
If you have a temporary illness, injury or required medical isolation for which you require adjustment, please notify Prof. Clark and your TF. You do not need a doctor's note or to state the nature of your illness, just how it will impact your participation in the class. Note that quizzes can be taken online over a week long period.

Accommodation for Religious Obligations
Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please communicate the need for a religious accommodation in a timely manner. In this class, please contact Prof. Clark and your TF to coordinate if religious observances conflict with completing course deliverables (e.g., quizzes or group projects). See the campus policy regarding religious observances for full details.

Preferred Student Names and Pronouns
CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Classroom Behavior
Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.
For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation
CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email CUreport@colorado.edu. Information about

university policies, reporting options, and OIEC support resources including confidential services can be found on the OIEC website.
Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about their options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

Mental Health and Wellness
The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact Counseling and Psychiatric Services (CAPS) located in C4C or call (303) 492-2277, 24/7.
Free and unlimited telehealth is also available through Academic Live Care. The Academic Live Care site also provides information about additional wellness services on campus that are available to students.

Acceptable Use of AI in this Class
Generative artificial intelligence tools—software that reproduces text, images, computer code, audio, video, and other content—have become widely available. Well-known examples include ChatGPT for text and DALL•E for images. This statement governs all such tools, including those released during our semester together. Keep in mind that the goal of gen AI tools is to reproduce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, relying on a gen AI tool may result in your submission of inaccurate content. It is your responsibility—not the tool's—to assure the quality, integrity, and accuracy of work you submit in any college course.

In preparation of your HW1 (review paper) and HW3 (research proposal) you may use generative AI tools to identify resources, summarize research papers for your review, help craft initial drafts or refine text. This may help you expedite reviewing many papers and narrowing down which require more careful review. However, as is the case for researchers in the field, you are responsible for the content that you submit and should have a firm understanding of not just the material that you submit, but also the materials upon which it is based. To assess this, we will perform brief oral interviews regarding your HW1 and HW3 submissions and their related topics. HW2 and HW4 should be your personal opinions in reviewing other papers and should not be developed using generative AI tools.