

**ASEN 5016
SPACE LIFE SCIENCES**

Spring 2020

**Tues/Thurs 4-5:15pm
Aero 111**

Instructor: Dr. David Klaus

telephone: (303) 492-3525

email: klaus@colorado.edu

office hours: Weds 2-3pm and Thurs 10-11am

Course TA: Michael Zero

email: michael.zero@colorado.edu

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 and spacesuits, as well as 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 20% - Exam 1

20% - Exam 2

5% - Take Home Quiz

5% - In Class Participation / Quick Quizzes

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’

TEXT Space Physiology, Buckley, 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 (not 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 (order and topics subject to minor revision)

Overview of Humans in Space

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
Wrap up / Exam Review
Exam 1 – Tues Feb 18

Human Physiological Adaptations to Space Flight

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

-- Spring Break Week 3/23-27

Wrap up / Exam Review
Exam 2 – Thurs Apr 2

Space Life Science Research

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 May 4, 2020 from 1:30 pm – 4:00 pm

Aerospace Engineering Sciences & University Policies 2019/2020

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see guidelines for [Temporary Medical Conditions](#) under the Quick Links at the [Disability Services website](#) and discuss your needs with your professor.

Religious Observances

[Campus policy regarding religious observances](#) states that faculty must make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See the [campus policy regarding religious observances](#) for full details.

Classroom Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment, *not only while in class, but also while working outside of class such as in labs and study areas*. Those who fail 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 differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the [policies on classroom behavior](#) and [the student code of conduct](#).

Sexual Misconduct, Discrimination, Harassment, and/or Related Retaliation

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate, *both in-class and outside of class*, acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU-Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the [OIEC website](#).

January 15, 2020

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to [the Academic Integrity Policy](#) of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the [Office of Student Conduct & Conflict Resolution](#). Students who are found responsible of violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at [Student Honor Code Policy](#)