January 09, 2022

ASEN 5016
SPACE LIFE SCIENCES

Spring 2022

Instructor: Dr. Allison Anderson

Course TA: Sage Sherman

Course TF: Hunter Hatchell

Course Zoom:

Classroom Recordings:

We will use Canvas' message 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 Sage, Hunter, and Dr. Anderson. 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 Dr. Anderson (and/or Sage, as appropriate) with the subject line "ASEN 5016: ___". During the first two weeks of class, all class activities will be remote and hosted over Zoom using the information above. Distance students can watch lectures online via the Zoom tab for the first 2 weeks and on the classroom capture website during the rest of the semester. The syllabus will be updated with the classroom capture website when it becomes available.

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

45% - Online Unit Quizzes, Best 5 of 6, 9% 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

5% - Participation (In Class or Online)

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.

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
(*order and topics subject to minor revision*)

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 21-25 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

Sunday *May 1, 2022 from 4:30 pm – 7:00 pm*

Aerospace Engineering Sciences & University Policies 2020/2021

1. **Requirements for COVID-19**

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus.

CU Boulder currently requires masks in classrooms and laboratories regardless of vaccination status. This requirement is a precaution to supplement CU Boulder's COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus. In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracing@colorado.edu).

2. **Accommodation for Disabilities**

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. 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.

3. **Classroom Behavior**

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. 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 race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on classroom behavior and the Student Conduct & Conflict Resolution policies.

4. **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.

5. **Honor Code**

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, 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. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu; 303-492-5550). Students found responsible for 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 Honor Code academic integrity policy can be found on the Honor Code website.

6. **Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation**

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu. Information about university policies, reporting options, and the support resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options. To learn more about reporting and support options for a variety of concerns, visit Don't Ignore It.

7. **Religious Holidays**

Campus policy regarding religious observances requires that faculty 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. In this class, please let me know at least 2 weeks in advance prior to any accommodations you may need for religious observances.

See the campus policy regarding religious observances for full details.