

**ASEN 5016  
SPACE LIFE SCIENCES**

**Spring 2021**

**Tues/Thurs 11:40-12:55pm MT  
Aero 114**

**Instructor: Dr. Torin Clark**

*email:* [torin.clark@colorado.edu](mailto:torin.clark@colorado.edu)

*office hours:* Friday 10-11am

**Course TA: Carlos Pinedo**

*email:* [carlos.pinedo@colorado.edu](mailto:carlos.pinedo@colorado.edu)

*office hours:* Wednesday 2-3pm

Open “office hours”  
Monday 12noon-1pm

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 Carlos and Dr. Clark. 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. Clark (and/or Carlos, as appropriate) with the subject line “ASEN 5016: \_\_\_”. I will try to answer within 24 hours.

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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.

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**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’*

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**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, 12<sup>th</sup> ed. Guyton and Hall, 2011 (& newer)*

*Fundamentals of Aerospace Medicine, 4<sup>th</sup> ed., Dehart and Davis, 2008 (& newer)*

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

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

*Medicine for Mountaineering* – general title, various options

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

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

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*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

## **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

*The week of March 22-26 will be used in this class as a spring pause to provide us all with a safe and supportive way to promote health, wellness and learning without leaving campus. During this week, we won't have any exams or assignments due. We will still have class with interactive class activities that will require your attendance and be part of your final course grade. March 25 is a wellness day and we will not have class that day. I wish we could take a regular spring break, but public health concerns prevent us from doing so. I would like to emphasize that it is still important for you all to behave responsibly. Do not use the week to travel or engage in risky behavior that could result in an outbreak on campus after we all return.*

## 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

*Wednesday May 5, 2021 from 4:30 pm – 7:00 pm*

## Aerospace Engineering Sciences & University Policies 2020/2021

### 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 Code of Conduct](#).

### Requirements for COVID-19

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements, and public health orders in place to reduce the risk of spreading infectious disease. Required safety measures at CU Boulder relevant to the classroom setting include:

- maintain 6-foot distancing when possible,
- wear a face covering in public indoor spaces and outdoors while on campus consistent with state and county health orders,
- clean local work area,
- practice hand hygiene,
- follow public health orders, and
- if sick and you live off campus, do not come onto campus (unless instructed by a CU Healthcare professional), or if you live on-campus, please alert [CU Boulder Medical Services](#).

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 policies on [COVID-19 Health and Safety](#) and [classroom behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the “Accommodation for Disabilities” statement on this syllabus.

All students who are new to campus must complete the [COVID-19 Student Health and Expectations Course](#). Before coming to campus each day, all students are required to complete the [Buff Pass](#).

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home. In this class, if you are sick or quarantined, please notify myself and your TA (Carlos Pinedo) as soon as you are able to do so. You do not need to state the nature of your illness or quarantine or provide a “doctor’s note”.

### **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](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.

### **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.

### **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 policy may include: 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](mailto: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

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as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the [Honor Code Office website](#).

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

The University of Colorado Boulder (CU Boulder) is committed to fostering an inclusive and welcoming learning, working, and living environment. CU Boulder 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 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 [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about the OIEC, university policies, [anonymous reporting](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when 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 options for reporting and support resources.

### *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 notify me in advance if you are unable to complete an assignment due to a religious holiday. See the [campus policy regarding religious observances](#) for full details.