

## **ASEN 5226: Medicine in Space and Surface Environments**

### **Instructional team:**

*The instructional team for this course includes several individuals involved in emergency medicine, space medicine, engineering, and wilderness medicine.*

*Your primary point of contact for the course is:*

Allison Anderson, PhD  
Smead Aerospace Engineering Sciences - Boulder  
AERO N303  
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Office hours: W 4-5 pm, N303

*Additional important instructors are:*

Ben Easter, MD  
Emergency Department - Anschutz  
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David Braun, PA  
CU Boulder Guest Lecturer  
UCHealth Acute Care  
[David.Braun-1@colorado.edu](mailto:David.Braun-1@colorado.edu)

**Lecture:** T 5:15 PM – 8:00 PM, AERO N250  
See “Schedule” section for additional pertinent information

### **1. Overview**

To maintain astronaut health and safety, advanced medical care will be a critical component for exploration environments, such as the surface of the Moon or Mars. The unique challenges imposed on engineers and medical care providers in these extreme environments will necessitate unique preparation and technology solutions. Further, to successfully work in exploration medical environments, there is an increased need for cross-pollination between medical practitioners and engineers designing the hardware and software used for medical care delivery.

The objective of this course is to provide an in-depth, experiential analysis of exploration medical capabilities. This course provides a unique learning opportunity focused on the medical challenges of human spaceflight. This is done both in the classroom and in an immersive field simulation that allows participants to engage in medical care in simulated planetary surface environments. This is achieved by offering a unique, evidence-based curriculum delivered by expert physicians, medical professionals, and engineers.

Lectures will occur on-campus at CU-Boulder for classroom-based learning on medical care in remote austere environments. Students will learn about patient assessment in the field and gain

certifications in Wilderness First Aid and CPR. The course will culminate in the field portion of the course. The field simulations will be conducted at the Mars Desert Research Station (MDRS) in Hanksville, UT and will be an integral part of the learning experience. Medical simulations are standard practice in the medical community and will provide an opportunity for students to practice the material offered in the lecture portion of the course and learn about additional considerations that can be best taught in the field.

The key learning objectives of this course are:

- 1) Perform simulated high-quality medical care employing creative solutions to overcome challenges of working in space and surface medicine.
- 2) Prescribe actions associated Wilderness First Aid (WFA) and Cardiopulmonary Resuscitation (CPR) training to perform basic medical skills for extreme environments.
- 3) Practice engineering under unique constraints associated with human spaceflight physiology and medical care in extreme environments.
- 4) Analyze differences between engineering and medicine learning devices to facilitate a common understanding across disciplines.

## 2. Assessment

Table 1 outlines the material by which students will be assessed. Details on this activity will be given during the first week of class and in the assignment document.

*Table 1: Distribution of course assessments for ASEN 5226*

Wilderness First Aid Exam	15%
CPR Certification	5%
Field Simulation Evaluations	40%
Project	20%
Final Exam	20%
	<b>100%</b>

Students will be graded using the standard grade scheme based on percentages. In other words, grades above 93% will receive an A, between 93% and above 90% will receive an A-, below 90% and above 87% a B+, etc.

The Final Exam will be given in a format familiar to those in the medical community but may be considered nontraditional in the field of engineering. To prepare for the exam, the Field Simulations will provide an opportunity for students to think about medical events in a group setting and evaluate all choices. For the Final, students will read a case report and prepare an assessment and care plan. Students may confer with all other students and resources in preparing this open-ended report for their submission. Each student will then have an individual oral examination where they must respond to questions from the instructional team and defend their evaluation to a panel of instructors. Individual evaluation times will be scheduled the week of April 10<sup>th</sup> and will primarily use the Tuesday class session. However, additional exam times may be required to accommodate all students. We will work with you to accommodate schedules.

## 3. Topics Covered

The following topics will be addressed:

- Brief overview of human physiological adaptation in space environments

- Detailed lectures on a variety of clinical issues and methods likely to be encountered in space and surface environments, including radiation treatment, musculoskeletal injuries, psychological disruption, barotrauma, search and rescue, extrication, etc.
- Diagnosis in austere environments, including training of non-medical personnel and medical devices
- Treatment in austere environments, including trauma, acute, and chronic medical conditions
- Supply resource management and planning (including pharmaceuticals through the project component, but not an exhaustive discussion)
- Physician, scientist, and engineer differences in thinking, training, and failure analysis
- Probabilistic risk assessments of medical events in space environments
- Medical device considerations, optimizing for flexible functionality, mass, power, and volume
- WFA and CPR training and certification

#### **4. Textbook**

The required textbook for the class will be associated with your WFA training. There may be additional readings distributed via Canvas as part of the course material to understand medical risk and care in the space environment.

The required textbook for the class is NOLS Wilderness Medicine, 7<sup>th</sup> Edition, by Tod Schimelpfenig. Other editions are acceptable as well. The reading schedule will be posted on Canvas, but may be subject to change since class progress may vary.

#### **5. Schedule**

A detailed schedule will be posted to Canvas. Lectures will be held on Tuesday evenings from 5:15-8:00 pm. Key information that is important to note on the schedule include:

- Attendance to all aspects of the class for the full duration is required. On an individual basis, if a conflict arises, please let Prof. Anderson know as soon as possible so we can ensure you can make up the material. These accommodations should only be pursued if absolutely unavoidable.
- We will have CPR certification on Feb. 7<sup>th</sup>. If you have previously been certified, this will be a good refresher. Please plan to attend as this is included in the course lab fee.
- The final exam will primarily be held on Tuesday April 11<sup>th</sup> and scheduled as an individual oral exam. Additional slots the week of April 10<sup>th</sup> may be required to accommodate all students. We will work with you to accommodate schedules.

A key aspect of this class is the field component, which will be held March 25<sup>th</sup> through April 1<sup>st</sup> at the Mars Desert Research Station (MDRS). A detailed field guide will be posted to Canvas. Key considerations for the field component include:

- You are expected to arrive in Hanksville by Saturday March 25<sup>th</sup> at 4:00 pm to settle into the field camp. You will be responsible for your own transportation via carpooling to and from MDRS, but we will help coordinate transportation among the students via Canvas. Additional information will be provided in class.
- Sunday March 26<sup>th</sup> – Saturday April 1<sup>st</sup>: We will complete additional lectures on specific medical risks, in-field medical simulations, sounding rocket payload launch, and the WFA course completion and exam.
- The Field component of the course will complete on Saturday April 1<sup>st</sup>. All participants MUST stay through the Saturday activities to help us secure and clean the facilities, and may not leave early.

## **6. Packing list and Supplies**

A detailed packing list can be found on the course Canvas website. Please review the packing list as soon as possible to determine what you are lacking. If you have issues finding any supplies, please let the instructional team know as soon as possible so we can help you find a solution. Note that the weather during the field component is anticipated to be cold and the environment is lacking traditional facilities, so you should plan accordingly. We will have potable water and port-a-potty toilets, as well as common facilities to cook food. You will not have access to electricity or internet. You may be able to have small text messaging capability, but do not anticipate the ability to make phone calls, use cell phone data, or charge a phone.

## **7. Additional Considerations**

Due to the nature of the class, we require all students to sign waivers and provide proof of insurance. These forms will be provided to you by the instructional team and you will have an opportunity to review them and ask questions in the first few weeks of class. You must also fill out a medical form to disclose any relevant medical conditions. Note that only licensed physicians will review these forms and it will have no bearing on the class other than to prepare for the in-field activity. The physicians will discuss with you any pertinent information on the form prior to arrival at MDRS, and this will be done on an individual basis under private circumstances. You must submit all forms by the stated deadline.

The State of Utah now requires anyone driving an electric rover to take an online vehicle safety course. We use electric rovers at MDRS as Mars Rovers, therefore everyone in the course will be required to complete this course, as all students might need to drive one at some point. We will provide you additional details as we learn them.

Providing food in the field environment is challenging, especially when trying to accommodate the needs of a large group. At the time of applying for the course, you disclosed any dietary restrictions you may have. We will work with you to accommodate dietary requirements, but we may need to have additional conversations with you to understand the nature of your dietary requirements. Most of the food that we will consume is shelf stable, so if you have significant restrictions, you may need to supplement with your own food supply. Note that food is cooked in a communal setting collaboratively with your classmates, so it is critical you are also an advocate of your dietary needs.

## **8. 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 [classroom behavior](#) policy, the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

## **9. 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. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff

must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking 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.

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](mailto: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](mailto:contacttracing@colorado.edu)).

Please alert me via email if you have an absence to the classroom portion of the course due to COVID-19. To participate in the field component, we require proof of vaccination and encourage you to receive a booster. All students are required to show proof of a negative PCR COVID test, regardless of vaccination status, acquired within 72 hours of arrival at MDRS. These can be obtained for free from campus medical facilities (Wardenburg) and may be scheduled in advance to ensure you meet the timing requirements. You cannot participate in the field component without proof of a negative test – this is a requirement of the Mars Society which owns and operates the facility. If you test positively, you will not be able to participate in the field week, and we will work with you as an individual to provide assessment for the course.

## **10. 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.

## **11. 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.

## **12. 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, 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 Student Conduct & Conflict Resolution ([honor@colorado.edu](mailto:honor@colorado.edu)); 303-492-5550). 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. Additional information regarding the Honor Code academic integrity policy can be found on the [Honor Code website](#).

### **13. Additional Considerations 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 sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about university policies, [reporting options](#), and 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 any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution options. To learn more about reporting and support options for a variety of concerns, visit [Don't Ignore It](#).

### **14. 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.