

ASEN 4519/5519: 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

Additional important instructors are:

Ben Easter, MD

David Braun, PA

Lecture:

See "Schedule" section for additional pertinent information

Zoom 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 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 goal of this course is to provide a focused analysis on 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) Enable an academic understanding of the challenges and solutions employed in working in space and surface medicine
- 2) Equip participants with Wilderness First Aid (WFA) and Cardiopulmonary Resuscitation (CPR) training so they have basic medical skills for extreme environments

- 3) Provide education of value to engineers involved in research on human spaceflight physiology and medical care
- 4) Expose engineers to common practice and learning devices employed in the medical community, such as medical simulations and group event analysis, to facilitate a common understanding across disciplines.

2. Assessment

Table 1 outlines the material by which students in the 4519 Section will be assessed. Table 2 outlines the material by which students in the 5519 Section will be assessed. Note that the primary assessment distinction between those taking the upper division section will be participation in the payload development activity for the rocket launch. 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 4519 Section

Wilderness First Aid Exam	15%
CPR Certification	10%
Field Simulation Evaluations	30%
Participation	15%
Final Exam	30%
	100%

Table 2: Distribution of course assessments for 5519 Section

Wilderness First Aid Exam	15%
CPR Certification	5%
Field Simulation Evaluations	30%
Participation	10%
Payload Development	15%
Final Exam	25%
	100%

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 4th 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 *Wilderness and Travel Medicine: A Comprehensive Guide*, 4th edition by Eric Weiss, MD. Other editions are acceptable as well. Additional readings outside this book may be provided.

5. Schedule

A detailed schedule will be posted to Canvas. Lectures will be held on evenings from 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. 22nd. 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.
- Tuesday March 1st will be primarily reserved for the engineering presentation associated with the graduate section. Those in the undergraduate section are required to attend and participate, as the engineering projects will have bearing on the rocket launch at MDRS (all students regardless of section participate in the rocket launch). Note that this timing then allows the students to fabricate their components for the rocket launch to be hosted on-site at MDRS.
- The final exam will primarily be held on Tuesday April 5th and scheduled as an individual oral exam. Additional slots the week of April 4th 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 19th through 26th 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 19th 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 20th – Saturday March 26th: 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 March 26th. 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.

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 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.

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. Code of Conduct

Due to the field component of this course, all students are expected to maintain high standards of conduct at all times including respect for persons and the environment. Students are expected to maintain best practices in self-care, including personal hygiene, sleep, nutrition, and a focus

on safety. Students are expected to maintain best practices in communal care, including respect for all individuals and their backgrounds, cleanliness of public spaces, care for the remote environment, and care for the habitat facilities we will be inhabiting for the week. No form of alcohol, tobacco, drugs, firearms, or sexual misconduct will be tolerated.

9. Requirements for COVID-19

We anticipate completing all aspects of the course, including the field component, this semester, but recognize the uncertainty associated with a class of this nature during a pandemic. The instructional team is prepared for any course pivots that may be required to adapt the class and still achieve the core learning objectives. We appreciate your flexibility as we strive to ensure a safe and positive learning experience under campus guidance.

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).

Living and working in the field poses unique challenges for a respiratory infection such as COVID-19. The Mars Desert Research Station is owned and operated by the Mars Society. We have provided the COVID-19 requirements of the Mars Society as they exist today; however, the Mars Society has the exclusive right to change these requirements at any point. Compliance with the Mars Society’s requirements is necessary to use their facility. In addition, the physician-instructors helping run the course reserve the right to make reasonable changes to COVID requirements (e.g., requiring masks) that they believe are in the best interests of the health and safety of the group.

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 for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.

11. 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](#).

12. 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.

13. 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](#).

14. 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](#).

15. 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.