**ASEN 4519/5519: Medicine in Space and Surface Environments**

**Instructional team:**
*The instructional team for this course includes 6 emergency medicine physicians (one of whom is international), 1 NASA flight surgeon, 3 NASA scientists developing exploration medical capabilities, 2 EMTs trained in wilderness medicine capabilities, and 1 engineer focused on developing medical capabilities for space applications. Your two primary points of contact for course questions are:*

Allison Anderson, PhD
Smead Aerospace Engineering Sciences - Boulder
AERO N303
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Office hours: Thursday 3-4 pm, N303

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**Lecture:** T 5:15 PM – 8:00 PM, AERO 232
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 necessitates 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 devices 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 and engineers.

Lectures will occur on-campus at CU-Boulder for classroom-based learning on medical care in remote austere environments. 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. See the "Schedule" section for more details.

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 Aerospace 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. Individual evaluation times will be scheduled during the Tuesday class session on April 7th.

## 3. Topics Covered

The following topics will be addressed:

- Brief overview of human physiological adaptation in space environments
- Physician, scientist, and engineer differences in thinking, training, and failure analysis
- Probabilistic risk assessments of medical events in space environments
- 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)
- Medical device considerations, optimizing for flexible functionality, mass, power, and volume
- WFA and CPR training and certification
- 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.

## 4. Textbook

The required textbook for the class will be issued as part of your WFA training. There may be additional readings around the course material that will be distributed prior to the course start date.

The required textbook for the class is Wilderness and Travel Medicine: A Comprehensive Guide, 4th edition by Eric Weiss, MD. Additional readings outside this book may be provided.

## 5. Schedule

A detailed schedule will be sent out prior to the initiation of the course. This course brings together subject matter experts from a variety of disciplines, therefore the schedule may be a little dynamic as we attempt to accommodate many different schedules. We appreciate your flexibility, and we will inform you of schedule changes as soon as we are made aware of them.

Lectures will be held on Tuesday evenings from 5:15-8:00 pm. We will not have lecture every Tuesday to comply with University rules on contact hours. Below is the current schedule, but the most detailed schedule can be found on Canvas:

January 14th – March 17th – Lecture Portion

- January 14th – Introduction, Project assignment, Basic Space Physiology
- Feb. 4th – WFA material, Medical Device Development for Space
- Feb. 11th – WFA material, Scenario practice
- Feb. 18th – CPR certification
- Feb. 25th – WFA material, Differences in Engineering, Scientist, and Medical thinking
- March 3rd – WFA material
- March 10th – WFA material
- March 17th – Rocket Project CDR, Final preparation for field component

March 21-28th – Field Simulations

- You are expected to arrive at MDRS by Saturday March 21st at 4:00 pm to settle into the field camp. You will be responsible for your own transportation to and from MDRS, but we

will help coordinate transportation among the group. Additional information will be provided in class.

- Sunday March 22nd – Saturday March 28th: Additional lectures on specific medical risks, in-field medical simulations, sounding rocket payload launch, WFA course completion
- The Field component of the course will complete on Saturday March 28th. All participants MUST stay through the Saturday activities to help us secure and clean the facilities, and may not leave early.

Final exam –

- Exam distributed no later than Tuesday March 31st
- Oral exams Tuesday April 7th – Schedule TBD

**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 either 1. Rent you equipment, or 2. Help you find another classmate with whom you can share. 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. 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, or sexual misconduct will be tolerated.

**5. 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 or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

**6. Classroom Behavior**

Students and faculty each have responsibility for maintaining an appropriate learning environment. 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.

**7. 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.

**8. 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); 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 at the Honor Code Office website.

**9. Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation**
The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, intimate partner abuse (including 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. Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website.

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

**10. 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.