

MCB-437/537
Life in Extreme Environments
Spring 2022
Course meeting: Tuesday and Thursday 12:30 PM – 1:45 PM
Room: BSW 208

Instructor Information

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Course Description

Extreme environments are numerous and diverse on Earth. Despite harsh environmental conditions, microbes have been found thriving from the deepest seafloors to the highest mountains, from the coldest polar regions to the hottest and most arid deserts or steaming hot springs. Microbes survival in such extreme and varied conditions allows them to play fundamental roles in global nutrient cycling. The course will encompass foundational material for the study of life in extreme environments.

In this course, we will examine microbial adaptations to their environment, how the adaptive responses affect microorganisms' evolution and how microorganisms modify their environment. We will consider physical extremes, such as temperature, radiation, pressure, and geochemical extremes (e.g., desiccation, salinity, pH, depletion of oxygen or extreme redox potential).

We will also assess how the study of life in extreme environments can provides critical elements of answer to important questions such as: "How did life appear on our planet?", "How microbes made Earth habitable?" and "Could life exist beyond our planet?", and explore the impact of human activity on ecosystems. Additionally, we will explore the wide application potential of this area of research in the fields of medicine, biotechnology, chemical and pharmaceutical industry, or cosmetics.

Course Goals

Students will be introduced to a wide range of topics related to the biogeochemical foundations of life in extreme environments. Students will be also expected to develop their scientific reasoning and writing skills as well as conduct independent literature reviews and synthesize their findings.

Course Structure

This course will cover different topics each week. For each topic, day 1 (Tuesdays) will consist in a lecture based on a survey of the literature, including group discussion. On day 2 (Thursdays), a group of graduate students will present a paper of their choice, followed by group discussion. Students will synthesize their findings into a Term Project.

Course Objectives

Undergraduate students: By participating in this course, students will:

- Gain fundamental understanding of life in extreme environments
- Learn how to find and identify important research papers
- Develop skills to critically discuss current research in the field
- Learn how to write and present their findings from the literature in the form of a review research paper and a short presentation to their peers

Graduate students: By participating in this course, students will:

- Strengthen and advance their understanding of life in extreme environments
- Critically evaluate research papers and develop skills related to critical thinking
- Work in small collaborative groups to discuss current research in the field and prepare “teaching-style” oral presentations
- Present their findings to their peers and encourage in-class discussion on a relevant research topic
- Write and present to the class a mock graduate fellowship proposal
- Give short “conference-style” oral presentations to their peers

Learning Outcomes

Undergraduate students: By participating in this course, students will be able to:

- Identify and summarize important knowledge related to life in extreme environments
- Critically discuss current research in the field
- Demonstrate their knowledge about the significance of current research in the field by writing a review research paper and giving a short presentation

Graduate students: By participating in this course, students will be able to:

- Identify and summarize important knowledge related to life in extreme environments
- Critically discuss current research in the field
- Prepare and present informative and pedagogical “teaching-style” oral presentations
- Prepare and present effective, informative, and persuasive “conference-style” oral presentations
- Demonstrate their knowledge about the significance of current research in the field by writing and presenting a mock graduate fellowship proposal

Registration and Prerequisites

MCB181R (or equivalent), completion of 1st semester organic chemistry and at least one upper division Molecular Biology, Biochemistry, Microbiology, or Astrobiology course (unless explicit instructor permission is received).

Course Format and Workload

Common to MCB 437 (undergraduate) and 537 (graduate): There will be no Final Examination. However, there will be a Term Project. See details below.

Participation in weekly discussions is a critical portion of your grade (see grading policies below). Failure to participate in a week's discussion will result in a score of "zero" for discussion that week. Exceptions will be made conflicts due to University-authorized commitments (pre-approved by the UA Dean of Students), or holidays observed by organized religion with which you are affiliated provided the instructor is contacted *before* the discussion is missed and proper documentation is provided.

For MCB 537 only:

Weekly reports: Students will select a theme they want to develop into a mock fellowship proposal for their Term Project. To be familiar with the literature of the selected theme, students will read one peer-reviewed article per week and submit a one paragraph summary of what the paper was about, what they found most interesting, and specifying an additional paper that they will read next, including justification. This process will be repeated every week for approximately ten weeks, with **reports due on Mondays 7AM**. The first weekly report is due on **Monday, January 17th**.

Term Project: The mock fellowship proposal will be two pages long, plus references. Additional expectations for the Term Project will be posted on D2L. The mock fellowship proposal will be due **on or before April 18th**. There will also be an accompanying in-class term project oral presentation held on **April 19, 21, 26, 28 and May 3, 5**. All students will be required to attend the term project oral presentations since their feedback will be evaluated.

Graduate students enrolled in MCB 537 will work in groups to prepare in-class presentation of a peer-reviewed article relevant to the week's theme (see schedule of topics below). In-class group presentations will be held on Thursdays. These presentations will encourage in-class discussions between students attending the class.

For MCB 437 only:

For undergraduate students, the Term Project will be a synthesis of additional scientific papers they will read during the semester in the form of a Mini Review. Students will select a theme of their choice and encouraged to read one paper of their choice per week. The Term Project Mini Review will be two pages long, plus references. Additional expectations for the Term Project will be posted on D2L. The Term Project Mini Review will be due **on or before April 18th**. There will also be an accompanying in-class term project oral presentation held on **April 19, 21,**

26, 28 and May 3, 5. All students will be required to attend the term project oral presentations since their feedback will be evaluated.

Undergraduate students enrolled in MCB 437 will be assigned homework. For more details on homework assignments issue and due dates, see the schedule of topics below.

Submitting Assignments

All assignments must be submitted in electronic format on D2L by the due date and time specified under the Schedule of Topics section below.

Grading Policy

Undergraduate students:		#	pt per assignment	total point	%
		assignments			
Homework Assignments		4	20	80	20%
Discussions	Tuesdays	12	5	60	15%
	Thursdays	12	10	120	30%
Term Project - Mini Review		1	70	70	18%
Term Project - Oral Presentation		1	70	70	18%
Total				400	100%

Graduate students:		#	pt per assignment	total point	%
		assignments			
In-class group presentations		4	25	100	19%
Weekly reports		10	10	100	19%
Discussions	Tuesdays	12	5	60	12%
	Thursdays	12	10	120	23%
Term Project - Mock Proposal		1	70	70	13%
Term Project - Oral Presentation		1	70	70	13%
Total				520	100%

Grades will be assigned as follows:

- A $\geq 90\%$
- B ≥ 75 and $< 90\%$
- C ≥ 60 and $< 75\%$
- D ≥ 50 and $< 60\%$
- E $< 50\%$

Final grades will not be scaled.

Incompletes (I) are only given at the instructor's discretion in the specific case of a student who is passing the course and has missed a portion of the assigned work.

Class attendance

- If you feel sick, or if you need to isolate or quarantine based on [University protocols](#), stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does **not** guarantee an automatic extension of due date or rescheduling of examinations/assessments.
 - Please communicate and coordinate any request directly with your instructor.
- If you must miss the equivalent of more than one week of class, please contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
- Voluntary, free, and convenient [COVID-19 testing](#) is available for students on Main Campus.
- If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for reporting a positive test, visit the [Case Notification Protocol](#).
- The COVID-19 vaccine and booster is available for all students at [Campus Health](#).
- Visit the [UArizona COVID-19](#) page for the most up-to-date information.

Absence Policy

1. The UA policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>
2. The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.
3. Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Participating in the course and attending lectures and other course events are vital to the learning process. **As such, attendance is required at all lectures and discussion section meetings.** If you miss class for any reason, please contact the instructor so we can discuss any barriers you have to attending class. Assignments due on the due date and time specified under the Schedule of Topics section below (or before). If an assignment is due, you are responsible for turning it in, even if you are absent from class. **Late work will generally not be accepted. However, if it is accepted, a penalty of 25% will be applied to the assignment's score for each day that the assignment late (i.e., if your score on the homework assignment would have been 85%, but it was handed in a day late, you will receive a score of 60%).** For the final project presentation, if you have reason to believe you will be absent from class, please let the instructor know in advance.

Expectation for Academic Honesty

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code

of Academic Integrity as described in the UA General Catalog. See:
<http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>

The University Libraries have some excellent tips for avoiding plagiarism, available at:
<http://new.library.arizona.edu/research/citing/plagiarism>

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

The instructor reserves the right to utilize electronic means to help prevent plagiarism. Students agree that by taking this course, all assignments are subject to submission for textual similarity review to turnitin.com. Assignments submitted to turnitin.com will be included as source documents into turnitin.com's restricted access database solely for the purpose of detecting plagiarism in such documents.

Classroom Behavior

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.). The use of cell phones and computers for activities outside of coursework is prohibited during class. Non-class activities are also prohibited (includes things like playing cards, playing with your dog, quilting, building a model airplane, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Attendance is required from all students at all lectures, and while in class, students are expected to conduct themselves in a considerate manner. Late arrivals and early departures are disruptive and not permitted. Students must disable cell phones for the duration of the class and refrain from answering calls (please take any emergency calls outside and explain them later). Students that persistently disrupt the class may be removed through the administrative drop procedure. Video recording in the classroom is not permitted without prior approval. No food or drink (except water) is permitted in this room and please clear up your seating area after use.

Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself.
See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

Academic advising: If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to advising@arizona.edu.

Life challenges: If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The [Dean of Students Office](#) can be reached at 520-621-2057 or DOS-deanofstudents@email.arizona.edu.

Physical and mental-health challenges: If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520-621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

Accessibility and Accommodations

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

UA Nondiscrimination and Anti-Harassment

The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>
Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Changes

The information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.

Required or Special Materials:

For this class you will need daily access to the following hardware: laptop or web-enabled device with microphone and webcam; regular access to reliable internet signal; ability to download and run the following software: web browser, Adobe Acrobat, Microsoft Word and Excel (or equivalent) to complete homework assignments.

Statement on compliance with COVID-19 mitigation guidelines: As we enter the Spring semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit www.covid19.arizona.edu for the latest guidance.

Class Recordings:

The course may be recorded. If students do not wish to be identified by name, please let the instructor know in advance.

For lecture recordings, which are used at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with UArizona values and educational policies are subject to suspension or civil action.

Schedule of Topics

We will endeavor to follow this class schedule as closely as possible throughout the term:

Week 1 Introduction to Life in Extreme Environments

Thursday, January 13: Syllabus review and introduction to the Term Project

Reading: Reading Selections will be Posted on D2L

Homework 1 issued: Due on Thursday, January 27 by 7AM

Week 2 Life in extreme habitats and what it means to be an extremophile

Tuesday, January 18: Lecture; Paper 1 Summary Due January 17

Thursday, January 20: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 3 What can we learn from extremophiles

Tuesday, January 25: Lecture; Paper 2 Summary Due January 24

Thursday, January 27: In-class group presentation; Homework 1 Due by 7AM

Reading: Reading Selections will be Posted on D2L

Homework 2 issued: Due on Thursday, February 17 by 7AM

Week 4 Life under low temperature

Tuesday, February 1: Lecture; Paper 3 Summary Due January 31

Thursday, February 3: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 5 Life under high temperature

Tuesday, February 8: Lecture; Paper 4 Summary Due February 7

Thursday, February 10: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 6

Life without water

Tuesday, February 15: Lecture; Paper 5 Summary Due February 14
Thursday, February 17: In-class group presentation; Homework 2 Due

Reading: Reading Selections will be Posted on D2L

Homework 3 issued: Due on Thursday, March 17 by 7AM

Week 7

Life under high salinity

Tuesday, February 22: Lecture; Paper 6 Summary Due February 21
Thursday, February 24: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 8

Life under high and low pH

Tuesday, March 1: Lecture; Paper 7 Summary Due February 28
Thursday, March 3: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 9

Applications to the Study of the Origin of Life and Exobiology

Tuesday, March 15: Lecture; Paper 8 Summary Due March 14
Thursday, March 17: In-class group presentation; Homework 3 Due

Reading: Reading Selections will be Posted on D2L

Homework 4 issued: Due on Thursday, April 7 by 7AM

Week 10

Life Under High Pressure and the Deep Biosphere

Tuesday, March 22: Lecture; Paper 9 Summary Due March 21
Thursday, March 24: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 11

Microorganisms in Oligotrophic Environments

Tuesday, March 29: Lecture; Paper 10 Summary Due March 28
Thursday, March 31: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 12 ***Organic Solvent Tolerant Microorganisms and Radiation Resistant Organisms***

Tuesday, April 5: Lecture; No Paper Summary Due

Thursday, April 7: In-class group presentation; Homework 4 Due

Reading: Reading Selections will be Posted on D2L

Week 13 ***Other Applications***

Tuesday, April 12: Lecture; No Paper Summary Due

Thursday, April 14: In-class group presentation

Reading: Reading Selections will be Posted on D2L

Week 14 ***Term Project Presentations***

Tuesday, April 19: Undergrad Term Project Presentations I

Thursday, April 21: Undergrad Term Project Presentations II

No Reading Assignments

Week 15 ***Term Project Presentations***

Tuesday, April 26: Undergrad Term Project Presentations III

Thursday, April 28: Undergrad Term Project Presentations IV

No Reading Assignments

Week 16 ***Term Project Presentations***

Tuesday, May 3: Grad Term Project Presentations I

Thursday, May 5: Grad Term Project Presentations II - Summary, Conclusions and Perspectives

No Reading Assignments