

# Evolutionary Environmental Physiology (IB 150, 3 units, Spring 2022)

Department of Integrative Biology, University of California, Berkeley

## COURSE INFORMATION

**COURSE FORMAT** Two lectures (1.5h/lecture, 3:30-5pm Tue/Thu, 166 Social Sciences Building) and one hour of discussion per week (12noon-1pm Fri, 202 Wheeler; OR 1-2pm Fri, 2062 VLSB).

**INSTRUCTOR** Caroline Williams  
Office: 5120 VLSB  
Office hours: 12noon – 1pm Mon, other times by appt.  
Email: [cmw@berkeley.edu](mailto:cmw@berkeley.edu)  
Webpage: [cmwilliamslab.com](http://cmwilliamslab.com)

**PREREQUISITES** Bio1A and Bio1B or equivalent

**COURSE OVERVIEW** Why do animals function the way they function? The natural world is a treasure-trove of biological diversity, the vast majority of which has arisen through adaptation to novel environments. Fluctuations in oxygen, temperature, water availability and salinity challenge physiological systems and have driven remarkable evolutionary innovations. In this course, we will embark on a quest to discover how physiological traits arise and are modified during adaptation to the environment. This course consists of three parts: 1) big questions in evolutionary physiology and how they are addressed; 2) physiological evolution in specific environments; and 3) student symposium. This course will have relevance to human biology, but will not specifically focus on human health sciences.

**LEARNING OBJECTIVES** This course aims to foster both content-specific knowledge and scientific enquiry and reasoning skills. As a result, this course will stimulate interest in the field of evolutionary physiology, and will also provide a solid preparation for the MCAT examination. The specific learning objectives are listed below.

### **Content-Specific Skills:**

Develop the ability to answer the following questions, and illustrate with examples:

**LEARNING OBJECTIVES CONT...**

- What is evolutionary physiology, what unique perspectives does it bring to the study of evolution, and what tools does it employ?
- How is genetic variation transformed into phenotypes, via biochemical and physiological processes; and how do those phenotypes influence fitness and thus genotype frequencies in the next generation?

- How does natural selection drive physiological evolution, and how are these processes modulated by phenotypic plasticity, resource trade-offs, or physiological constraints?
- How have organisms responded to some of the primary environmental selective pressures? Are evolutionary responses to these selective pressures predictable? What are the mechanisms and consequences of these responses?

**Scientific Enquiry and Reasoning Skills:**

- Integrate and synthesize material from a variety of sources
- Analyze evidence, form inferences, evaluate strength of inferences
- Graphical analysis and interpretation
- Interpret common inferential statistics used in this field
- Communicating science (written and oral)

METHODS OF INSTRUCTION

Lecture, discussion, team work, student research symposium, independent study.

ASSESSMENT

	% of Final Grade	Due date
Midterm I	10	2/8/22
Assignment 1 - News and Views article	10	3/11/22 (peer review 3/4/20)
Assignment 2 - Group article proposal	5 (team*)	3/14/22
Midterm II	15	3/17/22
Assignment 3 - Research symposium on physiological adaptation	25 (team*)	Weeks 12-14
Assignment 4 - Discussion section exercise (on seminar topic)	5 (team*)	Weeks 13 and 14
Debate participation	5	Weeks 11-12
Final exam	25	5/13/22, 7-10pm

\*Team final grade will be adjusted to reflect contributions to team

TEXTBOOK

Hill RW, Wyse GA, Anderson M (2014) Animal Physiology, Fourth edition. Sinauer Associates, Sunderland, MA, USA. Loose leaf edition acceptable.

ACKNOWLEDGMENT	This course was developed using materials kindly provided by Brent Sinclair, Lauren Buckley and Ray Huey, Elizabeth Dahlhoff, and Jonathon Stillman.
GRADING	If you are focused on obtaining a particular grade, planning ahead is key. Feel free to talk to me about the best strategies for obtaining the grade you need. Grade-focused conversations are welcome when they are proactive (still enough time in the course to impact the grade), realistic (the math adds up), and framed around concrete goals for the course.
LETTERS OF REFERENCE	If you want a letter of reference for medical school or graduate school, you will need to interact with me outside the classroom for me to get to know you sufficiently well to write a strong letter. Office hours are a great way to do this. If a request for a letter comes from someone who has not attended office hours, I will likely decline due to lack of first-hand information.
UC BERKELEY HONOR CODE	As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others.
ACADEMIC INTEGRITY	This class is a collaborative environment where we will work together on exciting challenges. Grading is not curved; you can all get excellent grades by working together and helping each other, thus fostering a vibrant learning community. Academic integrity is a fundamental component of achieving this goal. All students are expected to complete their work honestly. I will not tolerate acts of cheating, plagiarism, falsification, or attempting or assisting with an academic integrity violation. If I become aware of a potential academic integrity violation, I will meet with you following the procedures outlined in the Academic Integrity policy ( <a href="http://sa.berkeley.edu/conduct/integrity">http://sa.berkeley.edu/conduct/integrity</a> ). Should I determine that an academic integrity violation has taken place, I reserve the right to assign a grade penalty up to and including an F for the course. Students are expected to report possible academic integrity violations to me. As a tool to promote academic integrity in this course, written work submitted via bCourses may be checked for originality using Turnitin. Turnitin compares student work to a database of books, journal articles, websites, and other student papers. This creates an opportunity for students to improve their academic writing skills, by ensuring that other sources have been properly cited and attributed.
ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES	Please see me as soon as possible if you need particular accommodations, and we will work out the details.

## TENTATIVE COURSE SCHEDULE

<b>Principles of Evolutionary Physiology</b>		
1/18/22	Week 1	Lecture 1 – Intro. to Evolutionary Environmental Physiology
1/20/22		Lecture 2 – Environment, stress and plasticity
1/21/22		Discussion 1
1/25/22	Week 2	Lecture 3 – Physiological adaptation
1/27/22		Lecture 4 – Molecular evolution
1/28/22		Discussion 2
2/1/22	Week 3	Lecture 5 – Energy metabolism – genes to performance
2/3/22		Lecture 6 – Trade-offs and constraints
2/4/22		Discussion 3
2/8/22	Week 4	<b>Midterm I</b>
		News and Views instructions – Scientific Writing primer
		<b>Oxygen and carbon dioxide</b>
2/10/22		Lecture 7 – Altitude
2/11/22		Discussion 4
2/15/22	Week 5	Lecture 8 – Diving
2/17/22		Lecture 9 – Ocean acidification
2/18/22		Discussion 5
		<b>Water and solutes</b>
2/22/22	Week 6	Lecture 10 – Terrestrial water balance
2/24/22		Lecture 11 – Aquatic osmoregulation
2/25/22		Discussion 6
		<b>Temperature and seasonality</b>
3/1/22	Week 7	Lecture 12 – Ectotherm thermal performance curves
3/3/22		Lecture 13 – Behavioral thermoregulation
3/4/22		Discussion 7 - Peer-review of News and Views article
3/8/22	Week 8	Lecture 14 – Evolution of endothermy
3/10/22		Lecture 15 – Dormancy and migration
3/11/22		Discussion 8
3/15/22	Week 9	Lecture 16 – Midterm review
3/17/22		<b>Midterm II</b>
3/18/22		Discussion 9 – Debate prep
3/21-25		<i>Spring break</i>
		<i>Anthropocene adaptation</i>
3/29/22	Week 10	Lecture 17 – Climate change
3/31/22		Lecture 18 – Biological responses to climate change
4/1/22		Discussion 10 – Debate prep
4/5/22	Week 11	Lecture 19 – Evolutionary rescue and conservation strategies
4/7/22		Lecture 20 – Debate
4/8/22		Discussion 11 - Symposium prep (101, regular discussion (102)
4/12/22	Week 12	Lecture 21 – Debate
		<b>Symposium</b>
4/14/22		Symposium 1 (Teams 1 & 2)
4/15/22		Discussion 12 Symposium prep (102), regular discussion (101)

4/19/22	Week 13	Symposium 2 (Teams 3 & 4)
4/21/22		Symposium 3 (Teams 5 & 6)
4/22/22		Discussion 13 Symposium teams (Teams 1, 2, 5 & 6)
4/26/22	Week 14	Symposium 4 (Teams 7 & 8)
4/28/22		Final lecture
4/29/22		Discussion 14 Symposium teams (Teams 3, 4, 7 & 8)
5/13/22		Final exam

## DESCRIPTION OF ASSIGNMENTS

### ***Assignment 1 (individual, 10%) - News and Views article, final version due 3/13/20***

Write a short (500-800 words), engaging summary of a primary literature article describing a fascinating physiological adaptation, aimed at an educated member of the public. Submit a polished draft for peer review on 3/6/20, revise and resubmit by due date. A portion of your grade will be based on the completeness of the first draft and steps taken to revise it.

Examples: <http://jeb.biologists.org/content/by/section/OUTSIDE%20JEB>

Rubric: News and Views Rubric.pdf (Files > Assignments)

Detailed instructions: News and Views Instructions.ppt (Files > Assignments)

### ***Assignment 2 (team, 5%\*) - Group article proposal, due 3/16/20***

As a team, select an article for your symposium presentation (see below), and submit it for approval by answering the following questions:

- 1) Why did your team choose this paper?
- 2) What are the main discoveries in the paper?
- 3) How do these findings advance the state of knowledge?
- 4) Why do you consider this a “benchmark paper”?

### ***Assignment 3 (team, 25%\*) - Research symposium on physiological adaptation***

As a team, present the results of your chosen article as a conference-style presentation. Each team member will take a turn to present, with the full presentation being 20 min. At the end, your team will answer questions from the class about your article.

**Assignment 4 (team, 5%\*) - Discussion section exercise (on seminar topic)**

Your team will develop and lead a discussion section activity to consolidate a topic related to your symposium talk. You will assign some preparation material to your classmates, and then run an activity in class that solicits the active involvement of your classmates and teaches them a core concept in evolutionary physiology. After the activity, you will submit a lesson plan and brief reflection on what went well and how you would improve it next time.

\*Note of grading of teams: All grades for your team will be weighted by your contributions to the team. We will use the following evaluation form to monitor team dynamics. You will repeatedly evaluate your team to give members the opportunity to adjust performance to balance contributions. The final evaluation, at the conclusion of the symposium, will be used to weight the team grades.

**IB150: Evolutionary Environmental physiology - Team evaluations**

Using the table below, please score each team member below (1), meeting (2) or exceeding expectations (3) in each of the following categories:

Preparation – Did this team member come prepared?

Participation – Did this team member attend all meetings?

Contribution – When present, did they contribute to team success?

Team member	Name	Preparation	Participation	Contribution
Self				
1				
2				
3				

Comments (will be passed on anonymously):

Comments (confidential):