

IB 139: The Neurobiology of Stress and Resilience
Prof. Daniela Kaufer

Course Description/Summary:

Exposure to stress is an inevitable part of life and the body's response to stress can shape mental and physiological health. The study of stress is an interdisciplinary endeavor, and in this class we will examine basic, translational and clinical aspects of the stress response. We adopt a broad-based approach to explore the concepts of stress, health, and disease, and connect them to underlying neural mechanisms.

Major Course Themes:

- Impact of stress on the brain from cellular to behavioral functions and stress-related neuropsychiatric disorders (such as depression, trauma and anxiety)
- The biological basis to the individual variability in response to stress – how exposure to stress can be motivating and enhance performance of some, but induce anxiety and impede performance in others?
- Application of recent approaches to the study of stress, such as genetic, epigenetic, molecular, cellular, behavioral, cognitive and physiological approaches.

We will explore questions including:

- What is the physiological response to stress?
- What causes the individual variation in the response to stress?
- What is the relation between stress and mental wellness? Cognition?
- Can subjective appraisal of stress change the physiology of the response?
- Is there multigenerational transmission of the effects of stress?
- How does social context like isolation, poverty or racism affect stress circuitry and well-being?

Learning Objectives:

1. A mechanistic understanding of the Hypothalamic-Pituitary-Adrenal (HPA) axis.
2. Understand fundamental principles of neurobiology, physiology and anatomy as proximate mechanisms to the effects of stress on the brain and the body.
3. A working knowledge of the differential outcomes of exposure to stress across developmental and life stages.
4. Illustrate the relevance of basic stress research (from clinical and pre-clinical animal models) to many applied areas of health and well-being (such as clinical psychology, medicine, social welfare, education).
5. Learn to critically read and analyze primary literature.
6. Acquire knowledge of current research methods and skills for critical research design.
7. Provide a forum in which students from multiple disciplines with an interest in neurobiology, stress, and health care can come together.

Stress and Resilience – the practical toolkit: We are all facing new challenges and stresses in these unprecedented times. Therefore, this year I will add a practical resilience toolkit module for the course. This will be a completely optional (and ungraded) weekly session, where we will learn and practice tools like mindfulness, meditation, and gratitude to increase and sustain wellbeing and joy. This hands-on module is based on *Awakening Joy* by James Baraz, which I highly recommend reading, whether or not you plan to participate. <https://www.amazon.com/Awakening-Joy-10-Steps-Happiness/dp/1937006220>

Code of conduct

I am committed to creating an inclusive and welcoming environment in my classrooms and lab, for all community members. Rather than deny the discrimination and racial disparities present in the practice of science, we will acknowledge their presence and work on active solutions to address them.

All students are required to abide by the UC Berkeley Code of Conduct of academic integrity and inclusivity:

“As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others.”
The hope and expectation is that you will adhere to this code.

Rarely, I run across a student that tries to scam/hustle/cheat their way through a class. If any such fools are taking this class, I urge you to stop making yourself miserable. Learning is one of the rare and fortunate pleasures that we can have in this brief life. I hope that you can find fascinating things in this class that awaken an intellectual passion. If not, don't fake it. Just drop and do something you want to do.

Course format in Fall 20: The class will be offered remotely, and include 2 weekly synchronous 1.5 hr lectures (Tu, Th 9:30-11:00), and 1 hour of section (different times). The weekly time for the practical stress toolkit will be chosen together with the students that choose to participate. All the lectures and sections are recorded and made available on bcourses site, if you are unable to participate in the live meeting. I highly encourage you to come to the live sessions, as they include your participation in discussion, questions and breakout rooms. I assure you that you will get much more of this class this way.

Timeline of topics in lectures and section, and readings:

This timeline is approximate, and the exact correspondence between topic and date may not be maintained. I leave some flexibility to elaborate on topics that emerge from the classroom interest. The syllabus will be kept updated through bcourse site.

week	lecture	date	topic	reading (TBD)
1	1	8/27	Intro and Homeostasis	-
2	2	9/1	Control Systems, Stress and stressors	
	3	9/3	Neurophysiology – Cells of the nervous system	The structure and action of neurons – ch4 PDF
	<i>Section</i>	<i>#1</i>	<i>Neuroanatomy</i>	<i>NONE</i>
3	4	9/8	Neurophysiology - Action potential	Neurons communication Ch5 PDF
	5	9/10	Neurophysiology – synapses and neurotransmission	
	<i>Section</i>	<i>#2</i>	<i>Intro to Stress Studies</i>	<i>Heim et al. 2000</i>
4	6	9/15	Neurophysiology: circuits and systems	
	7	9/17	The HPA axis and Glucocorticoids and receptors	HPA axis
	<i>Section</i>	<i>#3</i>	<i>Stress and Aging</i>	<i>Epel et al. 2004</i>
5	8	9/22	The Autonomic nervous system	
	9	9/24	Allostasis, circadian rhythm	

	<i>Section</i>	<i>#4</i>	<i>Stress and Neuroplasticity</i>	<i>Mitra et al. 2005</i>
6	10	9/29	Neuroplasticity and memory - Hippocampus	
	11	10/1	The fear response - Amygdala	
	<i>Section</i>	<i>#5</i>	<i>Stress and Memory</i>	<i>Roosendaal et al. 2002</i>
7	12	10/6	Cognition and stress – appraisal and control	
	13	10/8	Executive functions – Prefrontal cortex	
	<i>Section</i>	<i>#6</i>	<i>REVIEW IN SECTION</i>	<i>NONE</i>
8	14	10/13	Midterm 1	
	15	10/15	The social brain	
	<i>Section</i>	<i>#7</i>	<i>Stress and Social Behavior Worksheet</i>	<i>NONE</i>
9	16	10/20	Stress and psychopathologies – Depression and addiction	
	17	10/22	Stress and psychopathologies – Anxiety	
	<i>Section</i>	<i>#8</i>	<i>Stress and PTSD</i>	<i>Yehuda et al. 2014</i>
10	18	10/27	Stress and psychopathologies –PTSD	
	19	10/29	Sex differences and stress across the life span	
	<i>Section</i>	<i>#9</i>	<i>Stress and Reproduction</i>	<i>Geraghty et al. 2015</i>
11	20	11/3	Individual variability and resilience	
	21	11/5	Biological sensitivity to context, GxE	
	<i>Section</i>	<i>#10</i>	<i>Genetic Sensitivity to Stress</i>	<i>Caspi et al. 2003</i>
12	22	11/10	Developmental programming	
	23	11/12	Transgenerational transmission of stress	
	<i>Section</i>	<i>#11</i>	<i>REVIEW IN SECTION</i>	<i>NONE</i>
13	24	11/17	Midterm 2	
	25	11/19	Stress and racism	
	<i>Section</i>	<i>#12</i>	<i>Epigenetics</i>	<i>Aoued et al. 2020</i>
14	26	11/24	Stress and socioeconomic status	
	27	11/26	THANKS GIVING	
			<i>No Section this week</i>	<i>NONE</i>
15	28	12/1	Interventions	
	29	12/3	Summary	
	<i>Section</i>	<i>#13</i>	<i>Stress and SES</i>	<i>Barrington et al. 2014</i>

Zoom Etiquette: We ask that you turn on your video in lecture and in section to encourage community building. Please let your GSI know if there are any concerns or questions. We will start on Berkeley time to give students time to have a break in between classes. Please be on time, use your real name, and mute your microphone when you aren't talking. The class will include interactions in lecture, and in breakout rooms. Please participate - this is the best way to be engaged and actively learn. You will be able to ask questions in person (use the raised hand function in zoom) and in the chat. Please only post chat messages relevant to the lessons.

Lectures: Tues/Thurs 9:30-11:00am, synchronous on zoom. Lecture recordings and slides will be made available on bcourses after each class. I highly encourage you to attend the live sessions. The class is heavily based on discussion and interaction.

Zoom Link:

Join from the bcourses site.

Discussion Group: 1 hour/week REQUIRED

You need to be enrolled and attending in one of the four sessions:

DIS 101 Tu 2:00P-2:59P | **Zoom Link:**

DIS 102 W 3:00P-3:59P | **Zoom Link:**

DIS 104 W 1:00P-1:59P | **Zoom Link:**

DIS 106 Th 2:00P-2:59P | **Zoom Link:**

Instructors:

Professor: Daniela Kaufer danielak@berkeley.edu
OFFICE HOURS: Tuesdays, 11:00-12:30, Zoom.

Zoom Link:

GSIs: Lisa Treidel lisa.treidel@berkeley.edu
Discussion Sections- 101, 104, and 105
OFFICE HOURS: Thursdays, 4:00-5:00, Zoom.

Zoom Link:

Alina Nguyen alina.nguyen@berkeley.edu
Discussion Sections- 102, 103, and 106
OFFICE HOURS: Wednesdays, 2:00-3:00, Zoom. **Zoom Link:**

Office Hours

Office hours are the best way to get really good feedback from us. If you have a complicated question, are struggling to understand something, or want to get into the nitty gritty, come to office hours of the professor or the GSIs. But, you don't have to have a specific question! It is also a great opportunity to get to know the Prof, the GSIs and your fellow classmates, and for us – to get to know you all better.

Prerequisites:

Bio1A (or a comparable class elsewhere) is highly recommended for this class. A good understanding of the fundamentals of biology will help you to do well in this class.

Readings:

Readings are posted on the bcourses site for each week.

Current research papers will be used to supplement the text and lectures.

Reading assignments for each lecture and section will be in the syllabus. Please read the assigned section before class. It will be expected that you have read the article prior to class. There will be a brief knowledge check assignment, due the day prior to your registered discussion section. You will have 1 week to complete the assignment. See grading section for details.

Bcourses site:

The bcourses site is updated after each lecture. In the Pages tab on the site you will find a page for each lecture. The page summarizes all the links that are relevant – the slides, the recording, links to topics that came up and additional readings, and the readings for the next lecture. It is therefore advised to check the pages after each lecture.

Grading:

Midterms 2 X 20=40%: The class will have 2 midterm exams (10/13 and 11/17). Information to be tested is a combination of information presented in lectures and sections and assigned readings. Attending lectures and sections is critical to your success in this course. The exam format will be short answer questions, open book/notes, and restricted to 24 hours for completion (**open 9:30am PST - closed 9:30am PST the following day**). The grades of the two midterms will be used in the grade calculation, each will account for 20% of the final grade.

But, sometimes life happens, and you may get a grade that you feel doesn't reflect the best you can do. In this case, you will have the opportunity to drop the lowest midterm grade, and exchange it for a written paper assignment. This gives you the opportunity to not be always perfect, as well as cover instances when you missed an exam because you are sick, have a med school interview, your cat ate your keyboard.

Final exam 45%: The final exam will be the same format as a midterm (all short answers, open book/notes, 24 hrs to complete) and be held on Dec 15th. The final will be cumulative (meaning comprehensive of the entire semester) and cover lectures, sections, and reading.

Discussion section grade 15%: Discussion is mandatory, and will cover new material that will be on your midterms and final. Section is 15% of your overall grade. Section grade consists of participation and written assignments.

Writing assignment before section (15%):

There will be a knowledge check writing assignment due 24 hours before your designated section time. The lowest grade from section assignments will be dropped. This means that you can miss 1 section for free. These are the days when you get sick, stay up all night, or just can't face the world. Keep it for when you need it.

Your grade in the course will be determined according to absolute standards of performance, hopefully relating your own acquisition of knowledge and understanding of the material. This means that **we do not curve the distribution of grades**, and that you are not in competition with fellow students.

The grades will be constructed of:

Midterms 40%

Discussion	15%
Final exam	45%

Total:	100
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Letter grades:

If your final course score is:	Your final letter grade will be:
≥95%	A+
≥90%	A
≥87%	A-
≥83%	B+
≥80%	B
≥77%	B-
≥73%	C+
≥70%	C
≥67%	C-
≥63%	D+
≥60%	D
<60%	F

Technology Access and Equity:

We realize that there is significant inequity in accessibility of remote learning. If you do not have access to technology, please check the Berkeley Student Technology Equity Program (STEP): <https://technology.berkeley.edu/STEP>. They provide long term loans for computers, mics, and other peripherals to students for free.

Students may not have in-person campus library access. We will be providing pdf files of the required readings for lectures, discussions and assignments on bCourses. If you would like to read the papers ahead of the posted schedule, or if you would like to access other literature that are not open access, you could use campus VPN (more information: <https://www.lib.berkeley.edu/help/research-help/remote-resources>), or email your GSI for assistance.

Mental Health and Wellness:

All students – regardless of background or identity – may experience a range of issues that can become barriers to learning. These issues include, but are not limited to, strained relationships, anxiety, depression, alcohol and other drug problems, difficulties with concentration, sleep, and eating, and/or lack of motivation. Such mental health concerns can diminish both academic performance and the capacity to participate in daily activities. In the event that you need mental health support, or are concerned about a friend, UC Berkeley offers many services, such as free short-term counseling at University Health Services. An excellent campus website having links to many resources is: <http://recalibrate.berkeley.edu>. Remember that seeking help is a good and courageous thing to do – both for yourself and for those who care about you.

Additional campus resources:

- **Disabled Students' Program (DSP)** - 260 Cesar Chavez Student Center, 642-0518
<http://dsp.berkeley.edu>

The Disabled Students' Program serves students with disabilities of all kinds, including mobility, visual, or hearing impairments; chronic illnesses such as AIDS, diabetes, and lupus; seizure disorders, head injuries, painful conditions such as back injuries and carpal tunnel syndrome; psychological disabilities such as bipolar disorder and severe anxiety or depression; attention deficit hyperactivity disorder; and learning disabilities. Services are individually designed and based on the specific needs of each student as identified by DSP's Specialists. The Programs official website includes information on DSP staff, UC's disabilities policy, application procedures, campus access guides for most university buildings, and portals for students and faculty.

- **Counseling and Psychological Services**, Tang Center – 2222 Bancroft Way, 642-9494
<http://uhs.berkeley.edu>

The UHS Counseling and Psychological Services staff provides confidential assistance to students managing problems that can emerge from illness such as financial, academic, legal, family concerns, etc. In the realm of sexual harassment, UHS coordinates education programs, crisis counseling, advocacy, and medical care for women and women who have been harassed or assaulted.

- **Student Learning Center** – 642-9494
<http://slc.berkeley.edu>

As the primary academic support service for students at UC Berkeley, the Student Learning Center (SLC) assists students in transitioning to Cal, navigating the academic terrain, creating networks of resources, and achieving academic, personal, and professional goals. Through various services including tutoring, study groups, workshops, and courses, SLC supports students in Biological and Physical Sciences, Business Administration, Computer Science, Economics, Mathematics, Social Sciences, Statistics, Study Strategies, and Writing.

- **Student Life Advising Services (SLAS)** – 642-4257
<http://slas.berkeley.edu>

Student Life Advising Services (SLAS) is an academic counseling/advising service that assists all undergraduate students, with a primary focus on Education Opportunity Program students and students who participated in outreach programs. The SLAS office assists students in developing the skills required to succeed at Berkeley and beyond by taking a comprehensive approach to counseling/advising on academic, personal, and social matters.

- **Ombudsperson for Students** – 102 Sproul Hall, 642-5754

The Ombudsperson for Students provides a confidential service for students involved in a University-related problem (either academic or administrative), acting as a neutral complaint resolver and not as an advocate for any of the parties involved in a dispute. The Ombudsperson can provide information on policies and procedures affecting students, facilitate students' contact with services able to assist in resolving the problem, and assist students in complaints concerning improper application of University policies or procedures. All matters referred to this office are held in strict confidence. The only exceptions, at the sole discretion of the Ombudsperson, are cases where there appears to be imminent threat of serious harm.

- **Student Advocate's Office** - 510-642-6912
<https://advocate.berkeley.edu/>

The Student Advocate's Office (SAO) is a non-partisan office of the UC Berkeley Student Government, the Associated Students of the University of California (ASCU). The SAO is staffed

by student caseworkers that can provide advice and guidance on academic conflicts, financial conflicts and resources, questions about code of conduct violations, and process general grievances. This is a free and confidential peer resource that can help assist connect you to appropriate campus partners in times of need.