

## IB 142L: Brain, Behavior, and Environment: a research approach

### Meeting Times and locations:



**Lecture:** T,Th: 11am-12:30pm in VLSB 3007

**Lab:** Th 2-5pm in VLSB 3030

**Units:** 5

### Instructor information:



**Professor:** Dr. Annaliese Beery, Ph.D (she/her)

**Office hours:** Tuesdays 9-11:00 am (in person or zoom)  
(first hour by appointment, second hour drop in)

**Office location:** VLSB 4098

**Zoom room:** <https://berkeley.zoom.us/my/abeery>

**Email:** [abeery@berkeley.edu](mailto:abeery@berkeley.edu)



**GSI:** Georgia Young (she/her)

**Office hours:** Mondays 2-3pm (in person or zoom)

**Office hours location:** VLSB 4184

**Zoom room:** <https://berkeley.zoom.us/my/gkyoung>

**Email:** [georgia.young@berkeley.edu](mailto:georgia.young@berkeley.edu)



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### Course Materials:



- Readings (PDFs of primary literature/book excerpts) posted on [bcourses.berkeley.edu](https://bcourses.berkeley.edu)
- Required text: *BEHAVE* by Robert Sapolsky (2017, any format); UC Berkeley library copies: <https://tinyurl.com/BBEtext>

### Course Description:

How do experiences and exposures get “under the skin” to impact human development? This course takes a research approach to understanding environmental origins of adult behavior. We begin with foundations in endocrinology, neurobiology, reproduction, and development. This sets the stage for studying the developmental impacts of experiences including nutrition, stress, immune challenges, endocrine disruptors, and more. Students will engage in authentic research using seasonal transitions in rodent physiology and behavior to understand adaptation to changing environments.

**Prerequisites:** Biology 1A or Psychology 110 or equivalent. This course assumes a good understanding of the fundamentals of biology as a starting place for this class.

### Learning Objectives (What are we here to do?)

The variety of potential contributing factors to behavior is at once overwhelming and fascinating. We will examine the roots of behavior through lenses ranging from neuroanatomy to social epidemiology. We will spend our days on the frontier of how our bodies develop differently depending on in utero hormone exposure, how what you eat programs your metabolism and that of future generations, how environmental exposures change your risk of aggression and impulsivity, and why some of our experiences and exposures can be passed down to offspring while others can't.

This class will also introduce students to research on physiology and behavior by conducting independent group research projects throughout the semester. Seasonal change provides a model of environmental influence we can use to ask questions about how animals adapt to survive both the “winter world” and warmer weather. How do hormones change across the year? How do environmental factors interact with one another to influence development? How do animals change their activity and social behavior across the seasons? Research investigations will parallel classroom topics, and will provide in-depth experience creating new knowledge about the origin of behavior.

### **Student Learning Outcomes:**

We will develop the capacity to:

- Read and critically analyze primary literature (scientific publications)
- Identify gaps in our understanding
- Synthesize knowledge across domains to study complex problems
- Conduct well-designed research studies that explore novel areas
- Explain scientific topics in detail in both written and oral formats

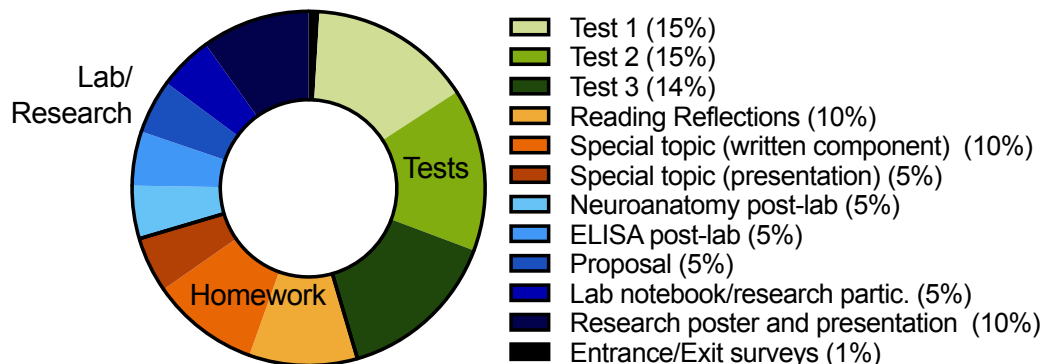
As class participants you are here not to receive information but to create understanding. As we move through the semester we will build on ideas, share half-formed thoughts, and strive for idea improvement. You will read, write, discuss, and hopefully have a great experience.

### **Expectations:**

To be actively involved in class you must be present, and I ask that you arrive to class on time and prepared. Good preparation does not mean that you have found all the answers but that you have read the assigned materials, thought about them deeply, and identified questions. The higher the level of class participation, the better this class will be. I ask that everyone participate in class by asking questions and engaging in discussion. If you have a question, most likely someone else in class has that same question. Thus, it is to everyone's benefit to hear your question. It is important to note that attendance is not the same as participation.

Developing our collective understanding is a group effort and you should strive to impress your colleagues (of which I am only one) with your engagement, ability to listen, involvement, thoughtfulness about ideas, and intellectual growth. We are all responsible for creating a learning environment that is welcoming, inclusive, equitable, and respectful. **This is your class**. If you feel that these expectations are not being met, please let me know, or consult campus resources linked through the accommodations hub: <https://evcp.berkeley.edu/programs-resources/academic-accommodations-hub#accommodations>.

### **Assignment Types and Grade Breakdown:**



**Research participation** is incorporated into the grade above for everyone. **Lecture participation** can adjust your final grade up or down by 0-3% (downward adjustments are typically reserved for unexcused absences).

**Extra credit** is available for attending and reflecting on course-related campus seminars (up to two). Seminar attendance can also be used to make up for missing reading reflections (see information below). There are excellent course-related seminars across multiple departments on this campus (Integrative Biology, Psychology, Neuroscience, Environmental Science Policy and Management, Public Health, etc.). Your GSI and I will try to highlight relevant upcoming talks as we learn about them; please let us know if you hear of seminars of interest to share.

### **Reading Reflections (RR)**

Reading reflections are due for many of the days with readings assigned (noted by an **RR** on the assignment sheet). *10 reading reflections should be completed for full credit.* These reflections are open-ended and should include brief summary followed by any of: questions you have, interesting ideas that come to you, critiques, connections you see...the list goes on. These reflections serve multiple purposes. I hope they will give you a concrete motivation to do the readings before the relevant class, help you to engage with the readings more deeply, and give us a sense of what each of you is thinking and understanding as the course progresses. They should be related enough to the text that it's clear that you completed the reading. If there are multiple readings, write about all of them, and try to find connections.

*Suggested format:* ~1 page single spaced; summary and questions followed by commentary. Reading reflections should be **pasted into the corresponding assignment in bCourses** by 11pm the night before class or turned in on paper at the start of class. Reading reflections are graded as 1/0.5/0 points. Scores <1 can be made up by additional reflections beyond the minimum required number of reflections. Make-up reflections can be drawn from other reading reflection days, or by attending and reflecting on a relevant campus seminar (see above).

### **Other Assignment Types**

Other written assignment types will be described in the handouts that accompany each project. Looking ahead to the “special topics” in the third unit: individually or with a partner, you will pick a topic that exemplifies the impact of the environment on brain and behavior to research and share with the class in multiple formats.

### **Late Policy**

Reading reflections that are turned in late will receive no credit, however only 10 reflections are needed for full credit. Reflections on approved extra credit talks may also be used to replace a reading reflection. All other homework assignments will be marked down 3% per day late unless otherwise pre-arranged.

### **Academic Accommodations**

Accommodations will be made for all students registered with DSP. See the DSP website: <http://www.dsp.berkeley.edu/> or the Academic Accommodations hub website: <https://evcp.berkeley.edu/programs-resources/academic-accommodations-hub#accommodations> for DSP and other campus resources. Please provide your written request to the instructor and your GSI within the first 2 weeks of the course.

### **Inclusion**

I'm committed to facilitating a learning environment that is enriching, validating, and accessible for all students, regardless of disability, background, identity, financial constraints, personal struggles, or other concerns. If you have concerns about course accessibility, equity, and inclusion that you would like to discuss with me, please don't hesitate to reach out.

### **Resources outside of class**

**Mental Health:** If you are experiencing stress, anxiety, or other distress, here are some campus and broader resources available.

UC Berkeley, Counseling and Psychological Services: All Berkeley students are eligible to use Counseling Psychological Services. You do not have to purchase the Student Health Insurance Plan to use these services. The first five counseling sessions are free for registered Berkeley students. Counselors can provide support in academic success, life management, career and life planning, and more.

- Call (510) 642-9494 or stop by the 3rd floor of Tang to make an appointment with a counselor.
- Drop-in counseling for emergencies: Monday - Friday, 10:00AM - 5:00PM
- After hours: call (855) 817-5667 for free assistance and referrals. Ask to speak with a counselor.
- For emergency support: Call UCPD 911 or (510) 642-3333

**24 Hour Crisis Hotlines:**

- Alameda County Crisis Line: (offers confidentiality, TDD services for deaf and hearing impaired callers and translation in 140 languages) Call 1-800-309-2131
- National Crisis Help Line: Call 1-800-273-TALK
- Crisis Text Line: Text HOME to 741741

**Other Campus Resources:**

- Let's Talk: Informal Drop-In Counseling <https://uhs.berkeley.edu/counseling/lets-talk>
- Self-Help Resources <https://uhs.berkeley.edu/mental-health/social-services/self-care-resources>
- Be Well at Cal <https://www.facebook.com/bewellcal/>

**Academic Dishonesty:**

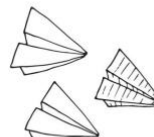
Academic dishonesty is **not** acceptable at UC Berkeley. Academic dishonesty is any action that may result in creating an unfair academic advantage for oneself or unfair academic disadvantage for another member of the academic community. Therefore, any exam, quiz, paper, and/or homework assignment submitted by you that bears your name should be your own original work. In all of your assignments, including your homework or drafts of papers, you may use words or ideas written by other individuals in publications, web sites, or even ChatGPT, but only with proper attribution. 'Proper attribution' means that you have fully identified the original source and extent of your use of the words or ideas of others that you reproduce in your work for this course, usually in the form of a footnote, parentheses or quotations. If you are not clear about the expectations for completing an assignment, be sure to seek clarification from the instructor or your GSI beforehand. **Cheating** and **plagiarism** are forms of academic dishonesty and are not tolerated under any circumstance. Any evidence of academic dishonesty will result in a score of zero (0) on that assignment or exam, and will be reported as soon as possible to the **Center for Student Conduct** (<http://sa.berkeley.edu/conduct>). This will result in a permanent scar on your academic record.

**Course Schedule:** [RR] = reading reflection (complete 10 of the 17 options)

**Note:** this is a **new** course, so our pace and corresponding small assignments due dates are subject to change as the course progresses! Major assignment dates will be held constant so you can count on tests and final projects occurring as referenced below.

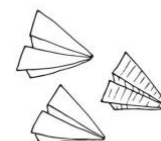
<i>Class</i>	<i>Assignment due by that class</i>
<b>UNIT 1: FOUNDATIONS (BRAIN AND BEHAVIOR)</b>	
Aug 24 (Th)	<ul style="list-style-type: none"> <li>• Course introduction/themes</li> <li>• People introductions</li> <li>• Group formation</li> <li>• Read some pop science...</li> </ul>
<b>NO LAB</b>	<ul style="list-style-type: none"> <li>• Come rested and ready!</li> <li>• <i>No lab first week of class</i></li> <li>• <i>No homework</i></li> </ul>
Aug 29 (T)	<ul style="list-style-type: none"> <li>• Evolution of behavior</li> <li>• Introduction to Ethology</li> </ul>
Aug 31 (Th)	<ul style="list-style-type: none"> <li>• READ: BEHAVE p. 4-13, 82-83 &amp; 328-340 [RR 1]</li> <li>• Course survey: pre-course component!</li> </ul>
Aug 31 (Th)	<ul style="list-style-type: none"> <li>• Brain and behavior: the autonomic nervous system</li> <li>• READ: Emotion text excerpt: p. 183-190 [RR 2]</li> <li>• [Note readings due for lab period as well]</li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• Introduce research model/topics</li> <li>• Lab notebooks, reading papers (GY)</li> <li>• READ: <a href="https://tinyurl.com/BBEwinter">https://tinyurl.com/BBEwinter</a></li> <li>• READ: Beery 2019 (foundation for lab research)</li> </ul>
Sept 5 (T)	<ul style="list-style-type: none"> <li>• Brain and behavior: the limbic system</li> <li>• READ: BEHAVE: Ch 2 p. 21-44 [RR 3]</li> <li>• READ: Anatomy of the nervous system 2.1 and 2.2</li> </ul>
Sep 7 (Th)	<ul style="list-style-type: none"> <li>• Brain and behavior: dopamine, reward, and adaptation to experience</li> <li>• READ: BEHAVE: Ch. 2 p. 64-80 “The mesolimbic...” and Ch 4. p. 99, 107-117 [RR 4]</li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• <b>Neuroanatomy Discovery Day</b></li> <li>• Plan hormone assays (take sample 1)</li> <li>• Optional: BEHAVE Appendix 1 (neuro overview)</li> </ul>
Sept 12 (T)	<ul style="list-style-type: none"> <li>• Endocrinology: what is a hormone?</li> <li>• Pituitary anatomy and axes</li> <li>• READ: Physiology excerpt: “Endocrine system”</li> </ul>
Sept 14 (Th)	<ul style="list-style-type: none"> <li>• Endocrinology methods: immunoassays</li> <li>• Dipstick activity (in class or lab)</li> <li>• READ: Immuno methods text excerpt</li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• <b>Hormone assay (ELISA)</b></li> <li>• Complete ‘PRE’-LAB during lab</li> <li>• <b>DUE Neuroanatomy Post-LAB (lab handout)</b></li> <li>• <b>Review</b> assay protocol</li> </ul>
Sept 19 (T)	<ul style="list-style-type: none"> <li>• Endocrinology: hormone axes</li> <li>• READ: BEHAVE Appendix 2</li> <li>• <b>DUE:</b> Special topic selection with literature search and brief (1-3 paragraph) description of interests</li> </ul>
Sept 21 (Th)	<ul style="list-style-type: none"> <li>• <b>In-class assessment 1: Hormones, Brain, &amp; Behavior</b></li> <li>• <b>STUDY</b> for Assessment 1 (make 1 page handwritten or otherwise unique guide sheet)</li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• <b>Hormone assay – data analysis</b></li> <li>• Complete <b>google form</b> related to research interests</li> </ul>

Onward to unit two!



## UNIT 2: EARLY LIFE – GESTATION

Sept 26 (T)	<ul style="list-style-type: none"> <li>Female reproductive cycle types, conception, and pregnancy</li> </ul>	<ul style="list-style-type: none"> <li>READ: Reproduction reading TBD</li> </ul>	<b>[RR 5]</b>
Sept 28 (Th)	<ul style="list-style-type: none"> <li>Hormonal control of pregnancy (including birth control and assisted reproductive technology)</li> </ul>	<ul style="list-style-type: none"> <li>READ: Endocrinology of Pregnancy (Hadley Ch. 19 excerpt pp. 436-439, 447)</li> </ul>	
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>Hormones and reproduction dry lab</li> <li>[special guest Dr. Young]</li> <li>Form research groups</li> </ul>	<ul style="list-style-type: none"> <li><b>DUE: Hormone assay POST-LAB</b></li> <li>Finish: Beery 2019 (foundation for model)</li> </ul>	
Oct 3 (T)	<ul style="list-style-type: none"> <li>Sexual differentiation</li> </ul>	<ul style="list-style-type: none"> <li>READ: Behavioral Endocrinology (Nelson and Kriegsfeld) Chapter 3 excerpt</li> <li>Sex redefined (Ainsworth, 2015)</li> </ul>	<b>[RR 6]</b>
Oct 5 (Th)	<ul style="list-style-type: none"> <li>Sex differences</li> </ul>	<ul style="list-style-type: none"> <li>BEHAVE: p. 210-222 (Boy and Girl brains?)</li> <li>Sex differences in the brain (McCarthy, 2015)</li> </ul>	<b>[RR 7]</b>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>Discuss: Strong Inference</li> <li>Group project background research</li> <li>Set up communication, begin proposal development</li> </ul>	<ul style="list-style-type: none"> <li>READ: Hiebert 2007</li> <li>Finish reading Beery et al. 2019 if not already done!</li> </ul>	
Oct 10 (T)	<ul style="list-style-type: none"> <li>Prenatal origins: exposures in pregnancy/history of endocrine disruption</li> </ul>	<ul style="list-style-type: none"> <li>READ: Excerpts from “Origins” (p. 94-108), “Tracking Toxics,” “Our Stolen Future”</li> </ul>	<b>[RR 8]</b>
Oct 12 (Th)	<ul style="list-style-type: none"> <li>Prenatal origins: endocrine disruption</li> </ul>	<ul style="list-style-type: none"> <li>READ: Executive summary to EDC-2</li> <li>Long-term effects of environmental endocrine disruptors on reproductive physiology and behavior</li> </ul>	<b>[RR 9]</b>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>Research project: planning and methods development</li> <li>Research project: pilot methods</li> </ul>	<ul style="list-style-type: none"> <li><b>Research proposal outline</b> with background, goals, methods, and 2 bibliography papers</li> </ul>	
Oct 17 (T)	<ul style="list-style-type: none"> <li>Prenatal origins: IVF and birth outcomes</li> </ul>	<ul style="list-style-type: none"> <li>READ: Developmental Origins of Health and Disease: The History of the Barker Hypothesis and Assisted Reproductive Technology (Carpinello et al. 2019)</li> </ul>	<b>[RR 10]</b>
Oct 19 (Th)	<ul style="list-style-type: none"> <li><b>In-class Assessment 2: Early Life – Gestation</b></li> </ul>	<ul style="list-style-type: none"> <li><b>STUDY</b> for test/assessment #2 (make 1 page optional guide sheet)</li> <li><b>DUE:</b> Special Topics choice by Oct 20 at <a href="https://tinyurl.com/BBEtopics">https://tinyurl.com/BBEtopics</a> (or full url on sheet)</li> </ul>	
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>Research project: pilot/collect data</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing project time</li> </ul>	



### UNIT 3: EXPERIENCE & EXPOSURE

Oct 24 (T)	<ul style="list-style-type: none"> <li>• Behavioral genetics and epigenetics</li> <li>• Developmental origins of health and disease (DOHD)</li> </ul>	<ul style="list-style-type: none"> <li>• READ: BEHAVE Ch 8 Part I &amp; Part II (p. 225-249) <span style="float: right;">[RR 11]</span></li> </ul>
Oct 26 (Th)	<ul style="list-style-type: none"> <li>• Video: Ghost in the Machine</li> </ul>	<ul style="list-style-type: none"> <li>• READ: Jablonka and Lamb “Excerpt from Evolution in Four Dimensions” excerpt <span style="float: right;">[RR 12]</span></li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• Research project: pilot/collect data</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Proposal due</b> with background, goals, methods, and 2 bibliography papers</li> </ul>
Oct 31 (T)	<ul style="list-style-type: none"> <li>• Genetics, epigenetics, and forms of inheritance</li> <li>• Special topics/student presentations _____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• Epigenetic and transgenerational reprogramming of brain development (Bale 2015) <span style="float: right;">[RR 13]</span></li> </ul>
Nov 2 (Th)	<ul style="list-style-type: none"> <li>• Early life social experience</li> <li>• Special topics/student presentations _____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• BEHAVE: Ch 7: Back to the Crib...p 174 -210 <span style="float: right;">[RR 14]</span></li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• Research project: collect data</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing project time</li> </ul>
Nov 7 (T)	<ul style="list-style-type: none"> <li>• Early life social experience</li> <li>• Special topics/student presentations _____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• Mothering style and methylation (Sapolsky, 2004)</li> <li>• <i>Abstract</i> of: Epigenetic programming by maternal behavior (Weaver et al. 2004)</li> <li>• <i>Abstract</i> of: Epigenetic regulation of the glucocorticoid... (McGowan et al. 2009) <span style="float: right;">[RR 15]</span></li> </ul>
Nov 9 (Th)	<ul style="list-style-type: none"> <li>• Stress</li> <li>• Special topics/student presentations _____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• READ: BEHAVE (p. 124-134) <span style="float: right;">[RR 16]</span></li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• Research project: collect data</li> <li>• Work on presentations</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing project time</li> </ul>
Nov 14 (T)	<ul style="list-style-type: none"> <li>• Special topics/student presentations _____/_____/_____ _____/_____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• Work on presentation/final assignment</li> </ul>
Nov 16 (Th)	<ul style="list-style-type: none"> <li>• Maternal signaling</li> </ul>	<ul style="list-style-type: none"> <li>• READ: Cortisol in mother’s milk across lactation reflects maternal life history and predicts infant temperament AND Mother’s littlest helpers (Hinde and Lewis, 2015) <span style="float: right;">[RR 17]</span></li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• <b>Project Poster Presentations!</b></li> </ul>	<ul style="list-style-type: none"> <li>• Be prepared to <b>present</b></li> </ul>
Nov 21 (T)	<ul style="list-style-type: none"> <li>• Special topics/student presentations _____/_____/_____ _____/_____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• Work on presentation/final assignment</li> </ul>
<i>Nov 23 (Th)</i>	<ul style="list-style-type: none"> <li>• <b>Thanksgiving — no class or lab</b></li> </ul>	<ul style="list-style-type: none"> <li>• <i>No homework</i></li> </ul>
Nov 28 (T)	<ul style="list-style-type: none"> <li>• <b>In-class Assessment 3: Early life exposures</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>STUDY</b> for Assessment 3 (make optional guide)</li> </ul>
Nov 30 (Th)	<ul style="list-style-type: none"> <li>• Special topics/student presentations _____/_____/_____ _____/_____/_____</li> </ul>	<ul style="list-style-type: none"> <li>• Work on presentation/final assignment</li> </ul>
<b>LAB (Th)</b>	<ul style="list-style-type: none"> <li>• Overflow lab period</li> </ul>	<ul style="list-style-type: none"> <li>• Complete exit survey and any remaining course work</li> </ul>

Please note that projects should be completed as soon as possible, but no work can be extended past the last instructional day of the semester (December 1) so please plan ahead!