



# Genetics of Behavior

## Biol L410/Biol Z620/ABEH 501

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Term: Spring 2020  
Class Meeting Days: T, Th  
Class Meeting Hours: 1:00-2:15  
Class Location: CISAB  
Office Hours: M, W  
Time TBD

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### I. Class Description

It is easy to accept the fact that certain individual human properties are in large part genetically determined. We have no difficulty in believing that our eye color, our hair, our height, or our blood pressure are features that vary due to the exact complement of inherited genetic variants. Yet, when it comes to our brains and our behavior, genetic determinism becomes more difficult to accept and is highly controversial. Do “behavior genes” exist? How would one define a gene as a behavior gene? These are some of the questions that we will attempt to answer in this class. The first part of the class will focus on courtship and “gender specific” behaviors. We will review the literature that demonstrates concrete examples of how single genes can affect these behaviors. We will examine the evidence from simple animals like insects as well as rodent models. Finally, we will examine the evidence that specific gene variants can affect human behavior and ask how selection on single genes may have shaped human language.

### Learning Objectives

The primary objective of this course is for you to learn how to read and think critically about scientific papers from the primary literature. By the end of the semester, you should be able to name understand the purpose of the standard sections of scientific papers and where to find the information that you are seeking. You should understand how to place the information from the paper into the context of what was known about the subject when the paper was written. You should be able to form new and testable hypotheses based on what you have read. You should understand the different ways that single genes can affect behavior. You should be able to provide examples of genes that do affect behavior and explain how they do this. You should be able to describe a “neural circuit” and explain how specific neural circuits can affect specific aspects of behavior (without affecting others).

**II. Basis for Final Grade**

Your final grade will be based on 6 written responses. For students enrolled in L410 there will also be a midterm exam (10%) and a final exam (10%) for L410. Z620 students take the midterm (10%) but will write a six-page single spaced term paper in place of the final exam (10%). The final term paper should address the learning goals for the class and discuss the ways in which genes affect behavior. This paper is expected to be based on readings from within and outside of class.

Assessment	Percent of Final Grade
Written responses 1-6	60% (10% each)
Participation	10%
Midterm Exam	10%
Presentation	10%
Final Exam/Term Paper	10%
	100%

**Written responses**

For class meetings that require a written response please write a two-page single space paper covering the relevant primary research articles. These written responses should offer your thoughts on **both** of the following questions: What are the major conceptual advances of the studies? And, what new questions have been raised and how might these be answered? This should be framed in the form of a **hypothesis** and a brief description of how the hypothesis can be **tested**. The entire response should fit onto two single-spaced page. A hard copy of this response should be printed out and brought to class. We will be discussing the responses in class and you will grade your own paper based on our discussion. The graded papers will then be turned in to me at the end of the class and I will make a final determination of your grade.

Your responses will be graded on a score from 1-10. 7 points will be assigned according to whether or not the key advances discussed in the papers were identified. 3 points will be assigned according to whether a testable hypothesis has been formed and discussed. Please bear in mind that you should not feel the need to address *every* next step; a carefully thought-out next question (hypothesis) with well-devised idea of how to test it is much better than a rambling list of untenable experimental ideas. Remember, you only have two pages – so clarity and brevity will be key!

Responses will be returned to you with a final grade after being reviewed by me. After considering our class discussion, you may revise and resubmit up to 3 responses for which you would like to improve your grade (up to 2 additional points (for a total of 10 points)). Resubmitted responses must be received within 7 days of the original due date. Note that revision is *optional* – if you’re satisfied with your response and grade, there’s no need to resubmit.

After you turn in your first assignment is turned in I will provide examples of excellent essays so that you can see what I am looking for in future assignments.

If you have to miss a class meeting for an unavoidable reason, please turn in your written response via email prior to the class meeting that you will miss.

**Presentations**

In the second half of the semester, you will be assigned a paper to present to the class on your own. For this presentation, you will be responsible for understanding and presenting each of the figures in the paper to the class. The figures in the paper should be incorporated into a powerpoint presentation. This

powerpoint should also include the necessary background that is needed to put the paper into context and descriptions of the methodologies that may be unfamiliar to the class. Finally, the presentation should conclude with some potentially interesting future directions that may come out of the paper. We will begin with the Z620 students first and the L410 students second.

For these classes, the assignment to members of group that are not presenting is to assemble a set of five questions that may be asked of the speaker. These questions must be submitted in writing prior to class on the day of the presentation.

### **Class participation**

Students are expected to arrive at the course meetings having read, carefully, the assigned primary research articles. **Attendance in class is mandatory, unexcused absences will result in a 3 point deduction from your class participation grade (out of the 10 total points).** Please be prepared to present *any* figure in the paper, as students will be randomly selected to present figures/figure panels during class. I understand that each of you will have different strengths and weaknesses so it is OK if there are aspects of the figures that you don't understand. You can see me in office hours or request help by e-mail if you find that this is the case. Or, you can work through the material with the class. Don't be shy if there is something that you don't understand. Chances are that you will not be alone as some of the material we are covering is very advanced. For each panel of each figure, please be prepared to answer the following **four** questions: 1) What were the authors asking? 2) What method did they use? 3) What did they find? and 4) Do you have any concerns regarding the authors' interpretation of their data? Additionally, students are expected to contribute to the end-of-class discussion, which will typically center on the impact and next steps of the work (i.e., those things to be covered in the written responses).

**Academic Integrity:** As a student at IU, you are expected to adhere to the standards and policies detailed in the [Code of Student Rights, Responsibilities, and Conduct \(Code\)](http://studentcode.iu.edu/) (<http://studentcode.iu.edu/>). When you submit an assignment with your name on it, you are signifying that the work contained therein is yours, unless otherwise cited or referenced. Any ideas or materials taken from another source for either written or oral use must be fully acknowledged. All suspected violations of the *Code* will be reported to the Dean of Students and handled according to University policies. Sanctions for academic misconduct may include a failing grade on the assignment, reduction in your final course grade, and a failing grade in the course, among other possibilities. If you are unsure about the expectations for completing an assignment or taking a test or exam, be sure to seek clarification beforehand.

### Supplemental Reading

1. The neurobiology of love. Zeki S. FEBS Lett. 2007 Jun 12;581(14):2575---9.

**Re: Note Selling:** Several commercial services have approached students regarding selling class notes/study guides to their classmates. Selling the instructor's notes/study guides in this course is not permitted. Violations of this policy will be reported to the Dean of Students as academic misconduct (violation of course rules). Sanctions for academic misconduct may include a failing grade on the assignment for which the notes/study guides are being sold, a reduction in your final course grade, or a failing grade in the course, among other possibilities.

Additionally, you should know that selling a faculty member's notes/study guides individually or on behalf of one of these services using IU email, or via Canvas may also constitute a violation of IU information technology and IU intellectual property policies and additional consequences may result.

1/14	Go over Syllabus/ Student Introductions/Knowledge Assessment	
1/16	1) Graduate students in class will discuss research interests. 2) We will talk about how to read a scientific paper.	Grad students bring ppt presentation with 3-5 slides
1/21	Reading 1: Are complex behaviors specified by dedicated regulatory genes? Reasoning from <i>Drosophila</i> . Baker BS, Taylor BJ, Hall JC. <i>Cell</i> . 2001 Apr 6;105(1):13--24. Review.	
1/23	Reading 2: <i>fruitless</i> splicing specifies male courtship behavior in <i>Drosophila</i> . Demir E, Dickson BJ. <i>Cell</i> . 2005 Jun 3;121(5):785-94.	
1/28	Reading 3: Neural circuitry that governs <i>Drosophila</i> male courtship behavior. Stockinger P, Kvitsiani D, Rotkopf S, Tirián L, Dickson BJ. <i>Cell</i> . 2005 Jun 3;121(5):795-807. PMID: 15935765	
1/30	In class discussion of written responses to papers 1-3 and grading of written responses.	Written response #1 on Readings 2 and 3.
2/4	Reading 4: Sex-specific control and tuning of the pattern generator for courtship song in <i>Drosophila</i> . Clyne JD, Miesenböck G. <i>Cell</i> . 2008 Apr 18;133(2):354-63. doi: 10.1016/j.cell.2008.01.050. PMID: 18423205	
2/6	Reading 5: Activation of Latent Courtship Circuitry in the Brain of <i>Drosophila</i> Females Induces Male-like Behaviors. Rezával C, Pattnaik S, Pavlou HJ, Nojima T, Brüggemeier B, D'Souza LA, Dweck HK, Goodwin SF. <i>Curr Biol</i> . 2016 Sep 26;26(18):2508-15.	
2/11	<b>Professor Carolina Rezával</b>	
2/13	In class discussion of written responses to papers 4-6 and grading of written responses.	Written response #2 on Readings 4-6
2/18	Reading 7: Loss of sex discrimination and male-male aggression in mice deficient for TRP2. Stowers L, Holy TE, Meister M, Dulac C, Koentges G. <i>Science</i> . 2002 Feb 22;295(5559):1493-500. Epub 2002 Jan 31. PMID: 11823606	
2/25	Reading 8: A functional circuit underlying male sexual behaviour in the female mouse brain. Kimchi T, Xu J, Dulac C. <i>Nature</i> . 2007 Aug 30;448(7157):1009-14. Epub 2007 Aug 5. PMID: 17676034	
2/27	<b>Professor Lisa Stowers? Scripps</b>	
3/3	In class discussion of written responses to readings 7&8 and grading of written responses	Written response #3 on Readings 7-9
3/5	Midterm Review	
3/10	Midterm Exam	
3/7	Return Midterm Exam	
3/17-19	Spring Break	
3/24	Reading 11: Enhanced partner preference in a promiscuous	Student paper

	species by manipulating the expression of a single gene. Lim MM, Wang Z, Olazábal DE, Ren X, Terwilliger EF, Young LJ Nature. 2004 Jun 17;429(6993):754-7.	
<b>3/26</b>	Reading 12 Galanin neurons in the medial preoptic area govern parental behavior By: Wu, Zheng; Autry, Anita E.; Bergan, Joseph F.; et al. NATURE Volume: 509 Issue: 7500 Pages: 325-+ Published: MAY 15 2014	Student Paper
<b>3/31</b>	Reading 13 Functional identification of an aggression locus in the mouse hypothalamus. Lin D, Boyle MP, Dollar P, Lee H, Lein ES, Perona P, Anderson DJ. Nature. 2011 Feb 10;470(7333):221-6.	Student Paper
<b>4/2</b>	<b>Professor Dayu Lin NYU</b>	Written response #4
<b>4/7</b>	Reading 14 Genetic variation in a human odorant receptor alters odour perception. Keller A, Zhuang H, Chi Q, Vosshall LB, Matsunami H. Nature. 2007 Sep 27;449(7161):468-72. Epub 2007 Sep 16.	Student Paper
<b>4/9</b>	Reading 15 Functional evolution of mammalian odorant receptors. Adipietro KA, Mainland JD, Matsunami H. PLoS Genet. 2012;8(7):e1002821. doi: 10.1371/journal.pgen.1002821	Student Paper
<b>4/14</b>	Reading 16 The missense of smell: functional variability in the human odorant receptor repertoire. Mainland JD, Keller A, Li YR, Zhou T, Trimmer C, Snyder LL, Moberly AH, Adipietro KA, Liu WL, Zhuang H, Zhan S, Lee SS, Lin A, Matsunami H. Nat Neurosci. 2014 Jan;17(1):114-20. doi: 10.1038/nn.3598.	Student Paper
<b>4/16</b>	In class discussion of written responses to papers 14-16 and grading of written responses.	Written Response #5
<b>4/21</b>	Reading 17 Molecular evolution of FOXP2, a gene involved in speech and language. Enard W, Przeworski M, Fisher SE, Lai CS, Wiebe V, Kitano T, Monaco AP, Pääbo S. Nature. 2002 Aug 22;418(6900):869-72	Student Paper
<b>4/23</b>	Reading 18 FoxP2 expression in avian vocal learners and non-learners. Haesler S, Wada K, Nshdejan A, Morrisey EE, Lints T, Jarvis ED, Scharff C. J Neurosci. 2004 Mar 31;24(13):3164-75.	Student Paper
<b>4/28</b>	Reading 19 A humanized version of Foxp2 affects cortico-basal ganglia circuits in mice. Cell. Enard W et al 2009 May 29;137(5):961-71. doi: 10.1016/j.cell.2009.03.041.	Student Paper

<b>4/30</b>	Review Session for final	Written Response 6
<b>TBD</b>	Final Exam for undergraduate students.	
<b>5/6</b>	Graduate Student (Z620) Term Paper is Due	