

HUMAN BIOLOGY: EPIGENETICS, GENETICS AND EVOLUTION
BIO346, FALL 2018

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Please e-mail for appointments or emergencies only, and be sure to put "BIO346" in the subject heading. We are happy to meet students during office hours, but it is really inefficient to answer questions about the course over email. Plus we'd rather get to know you in person.

Attendance at exams is required. You must take exams in the registered period. Make-up exams are only by prior arrangement, in the case of extreme and documented reasons. Make-up exams may take a different form than the regularly scheduled exam, including essay exams for example.

This is a fun but challenging course that surveys the molecular and evolutionary underpinnings of human physiology and behavior. The course is intended as a broad summary and synthesis of diverse areas of biology with an emphasis on its unifying concepts. Material is organized into three broad themes: 1. **Epigenetics, genetics and society**. 2. **Human diversity**, and 3.

Becoming human. The class will use principles of biology that are derived from work with many species and apply them to understanding human form and function. The first theme, *Epigenetics, genetics and society*, discusses how our experience in the world interacts with our genome. *Human diversity* explores concepts of race, geographic variation, population evolution and recent human history. The last theme, *Becoming human*, moves progressively farther back in time to understand the origins of the structure of our bodies and the cells that comprise them. The class assumes a familiarity with Mendelian genetics and molecular genetics, including the mechanisms of eukaryotic gene regulation. Students are expected to be proficient with the concept of phylogeny. **These expectations are based on students having successfully completed the required pre-requisite courses BIO311C, BIO311D, and BIO325, or their equivalents.** Our major learning objectives are to:

1. Understand the molecular basis of interactions between genomes and environments
2. Understand how societal factors (poverty, stress, trauma) influence genome function
3. Understand genetic contributions to health and disease
4. Describe how human movements have shaped genetic variation
5. Detect evidence of natural selection within the genome
6. Understand how selection and mutation shape health and disease
7. Identify the relationship between the human body and its homologs in other species
8. Understand the continuity of biological processes across timescales

The class meets Tuesday and Thursday from 9:30am-11am. There are weekly discussion with times varying according to section. To evaluate your understanding, there will be three in-class exams, three quizzes, and some miscellaneous assignments. Exams emphasize integration and application of concepts, and are designed to mimic the range of questions students can expect to find on pre-professional exams, like the Medical College Admissions Test. Grades will be weighted as follows.

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|--------------------|---|--------|
| Exam 1, | Tuesday, October 2 | 100pts |
| Exam 2, | Thursday, November 1 | 100pts |
| Exam 3, | Thursday, December 6 | 100pts |
| Discussion section | | 100pts |
| | Discussion participation and attendance | 20pts |
| | Quizzes, 3 @ 10pts | 30pts |
| | Additional assignments TBD | 50pts |

Total

400pts

Scores on tests will be curved. We will calculate the curve by averaging the top three scores in the class, subtracting the average from 100, and adding the difference to everyone's exam scores. The total percentage of correct items will be converted into letter grades using the familiar standards: A = 90.0-100, B = 80.0-89.9, C = 70.0-79.9, and D = 60.0-69.9.

The course reading will be a mixture of scientific and popular press articles distributed as *pdf* files. These *pdfs* are available in the course Canvas site. Underlined readings are original scientific papers (so allow more time to get through them). Items in blue refer to the discussion section.

| | <u>Theme 1: Epigenetics, genetics & society</u> | <u>Student reading</u> |
|--------|--|---|
| 30-Aug | Introduction: epigenetics, genetics & evolution No discussion | |
| 4-Sep | Epigenetics defined | Bonetta 2008, Mukherjee 2016 |
| 6-Sep | Developmental origins of health and disease What is epigenetics? DTC genetic test | <u>Barker 1990</u> Coyne blog post |
| 11-Sep | Parenting, stress and poverty | Sapolsky 2005, <u>Hackman Meaney 2010</u> |
| 13-Sep | Sexual differentiation Quiz 1: Epigenetics and early life | |
| 18-Sep | Transgenerational epigenetics | Rando 2015, <u>Heijmans et al 2008</u> |
| 20-Sep | Heritability, mutation and association Epigenetics of the holocaust? | Wray 2008, <u>Kruglyak 2008</u> , Maher 2008 Yehuda et al 2016 , Guardian vs Ewan Birney |
| 25-Sep | Heritability, mutation and association | |
| 27-Sep | <i>Review</i> Heritability and epigenetics problems | |
| 2-Oct | Exam 1 | |
| | <u>Theme 2: Human diversification</u> | |
| 4-Oct | Geographic variation and race Genetics, drift and migration -- in class problems | <u>Parra et al. 2003</u> <u>Barbujani and Colonna 2010</u> |
| 9-Oct | Drift, mutation and migration | Cavalli-Sforza 1969 |
| 11-Oct | Ancient migrations Population genetics take-home quiz | (Barbujani and Colonna 2010) Bersaglieri et al 2004 |

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|--------|---|--|
| 16-Oct | Population genetics, selection and disease | |
| 18-Oct | Evolution in response to climate <i>Lactase persistence module</i> | Jablonski and Chapin 2003, Jablonski 2010 |
| 23-Oct | Evolution of agriculture and diet | Cochran and Harpending 2009 (Ch 3), Curry 2010 |
| 25-Oct | The genus Homo <i>Neanderthal module</i> | Pontzer 2012 |
| 30-Oct | Review | |
| 1-Nov | Exam 2 | |

Theme 3: Becoming human

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|--------|--|------------------------------|
| 6-Nov | Phylogeny, brains and cognition | <u>Boyd Silver 2015</u> |
| 8-Nov | Phylogeny, brains and cognition <i>Phylogeny & adaptation</i> | Pollard 2009 |
| 13-Nov | Sensation: Sight, smell, sound | <u>Gilad Paabo 2004</u> |
| 15-Nov | Primate sexuality & attachment <i>Quiz: Brain, behavior and evolution</i> | <u>Fisher Brown 2005</u> |
| 20-Nov | Limbs | <u>Prabhakar Noonan 2008</u> |
| 22-Nov | <i>Thanksgiving</i> <i>Development and limb evolution</i> | |
| 26-Nov | Limbs | Riddle & Tabin 1999 |
| 29-Nov | Guts <i>Metabolism module</i> | <u>Yei Keenan 2017</u> |
| 4-Dec | Tissues, cells & nuclei <i>Dec 5: Special evening review</i> | <u>Mattioli Luger 2017</u> |
| 6-Dec | Exam 3 | |