

## IB 160: Evolutionary Biology Syllabus and Course Organization

**Instructors:** TBD

**GSI:** TBD

**Standard office hours** are as follows: KP, M 11-12 (5099 VLSB); NW, W 1-2 (4094 & 4095 VLSB); SH, F 3-4; BM, Th 10-11. If you cannot make these, please contact us by email! We're happy to meet you at a different time.

**Lectures** are held at 10-11am, MWF, 4 LeConte Hall.

**EVOLUTION** is one of the most important ideas in the history of civilization. It fundamentally changed how we look at the living world and ourselves as humans. Together with discoveries about astronomy, geology, and physics in the early years of the Enlightenment, it forged a view of the natural world that was less centered on humans and more on a biota, an Earth, and a cosmos that had been changing for billions of years. Darwin's concept of evolution convinced most people that all organisms had a common ancestry, and that processes that had been operating on heritable variations in natural organisms for millions of years had shaped populations and lineages, diversifying and pruning them, to produce the spectacular biotas of the past and present.

This course will talk first about what evolution is, and what science is (and is not). You will learn about how present-day ideas about evolution themselves "evolved," and about other scientific disciplines in which important ideas were developed that integrated well with our understanding of evolution. We'll discuss several levels of evolution. The population level is perhaps most familiar to students coming into the course, and many people know a good bit about genetics and genomics. The third level, with which we'll start our discussion of the levels of evolution, is macroevolution – what happens at the large scale in biological diversity through time, the processes and patterns, and how they help us to understand evolution in the world today. And we'll relate the principles of evolution to subjects such as the factors that differentiate the sexes, how social customs come to be, and the emergence of humans from other apes.

Yes, as many of you are wondering: you will be responsible for all of this; so it is a bit different than many science classes you've taken, especially if you haven't had many upper division courses yet. You will find that although there is a lot of stuff we want you to rote-remember, as in any class, just as important in this class is the **analysis and manipulation of evidence and ideas** in order to test hypotheses about nature. You will need to understand and know a certain amount of information, including how various evolutionary and other mechanisms work, in order to do that. You will find that **analytical thinking** is required here perhaps more than in many other science courses you've taken. We will also expect you to **write**, because good writing requires clear thinking. We expect this course to be an intellectual challenge to some extent, because that's what university courses should be. Evolution is an endlessly interesting subject, and our goal for you is to be able to put all its amazing processes, patterns, and levels together to come out with an

integrated idea of what evolution is and why it is so central to biology. Evolution is one of the very few most important game-changing ideas in the history of civilization. Enjoy the ride.

## COURSE SYLLABUS

[**Note:** Lectures in **green** will be given by Professor Noah Whiteman. The others are given by Professor Kevin Padian.]

### I. Introduction and History of Evolution

- 8/23: 1 – Evolution, science, and anti-science: the current threat to rationality.  
8/25: 2 – What is evolution? – The major questions in evolutionary biology. [Ch. 1]  
**No discussion section today.**  
8/28: 3 – How the idea of evolution evolved. – What Darwin said and didn't say. [Ch. 2]  
8/30: 4 – Evolution since Darwin: Modern Synthesis and ... "post-modern" synthesis? [Ch. 2.4]  
9/01: 5 – Homology as the central concept in comparative biology.  
**First discussion section today.**  
9/04: **LABOR DAY -- NO CLASS**

### II. The structure of evolution in time and space: homology, systematics, biogeography

- 9/06: 6 – Systematics: how evolutionary relationships are constructed. [Ch. 4.1-4.3]  
9/08: 7 – How phylogenetic trees test evolutionary hypotheses.  
9/11: 8 – Using phylogenies to test evolutionary questions. [Ch. 4.4-4.7]  
9/13: 9 – Origin & evolution of the solar system & Earth – establishing the conditions for life.  
9/15: 10 – Historical biogeography: one half of knowing why organisms live where they do. [Ch. 14.1]  
9/18: 11 – Ecological biogeography: the other half of why organisms live where they do.

**Monday, Sept. 18: Q&A session 7-9 pm, 2040 VLSB. Exam material goes through 9/18.**

**Thursday, Sept 21: FIRST MIDTERM EXAM (7-9 pm, Evans 10)**

### III. Macroevolution: explanations of the great patterns in the history of life.

- 9/20: 12 – Speciation rates as the motor of evolution. [Ch. 14.2]  
9/22: 13 – How change occurs during speciation: Punctuated equilibrium vs. gradualism. [pp. 461-463]  
9/25: 14 – Diversity through time. Patterns of change in the history of life. [Chs. 3 & 14.3-14.4]  
9/27: 15 – Extinction. Background and mass extinction. Are we still in a mass extinction? [Ch. 14.7-14.9]  
9/29: 16 – Adaptation: its hierarchical study from populations to clades. [Ch. 14.5-14.6; Ch. 10.6, 10.10, 10.11]  
10/02: 17 – Adaptation, exaptation, and constructional morphology: what determines form? [Ch. 10.8-10.11]  
10/04: 18 – Origins of major adaptations: life on land, flight, and the return to water. [Chs. 3.10, 3.11, & 1.1]  
10/6: 19 – Adaptive and non-adaptive radiations; "recovery" from diversity crises. [Ch. 14.5]

### IV. Population-level evolution and speciation

- 10/9: 20 – Where does variation come from and how is it explained? [Ch. 5] **First writing assignment due in class.**  
10/11: 24 – What processes structure and change variation in populations? [Ch. 6]  
10/13: 25 – More processes that structure and change variation in populations [Ch. 6]

- 10/16: 26 – Speciation: Processes that encourage differentiation of populations. [Ch. 13]  
10/18: 27 – Speciation mechanisms [Ch. 13]  
10/20: 28 – Speciation and its relationship to macroevolution. [Ch. 13]  
10/23: 21 – How do genes work? Gene structure & expression in the phenotype [Ch. 5]  
10/25: 22 – Beyond Alleles: quantitative genetics and the evolution of phenotypes [Ch. 7]  
10/27: 23 – Quantitative Genetics and the Evolution of Phenotypes [Ch. 7]

**Tuesday, October 31: Q&A session 7-9 pm, 2060 VLSB. Exam material goes through 10/23.**

**Thursday, November 2: SECOND MIDTERM EXAM (7-9 pm, Evans 10)**

## **VI. Evolutionary genetics and genomics**

- 10/30: 29 – Natural selection in the lab and in the wild [Ch. 8]  
11/01: 30 – The History in our Genes: DNA, Genes, and Molecular Phylogenies [Ch. 9]  
11/03: 31 – Coalescence, clocks and footprints of selection [Ch. 9]  
11/06: 32 – Evolution and Genomes: from descriptive to comparative genomics [Ch. 9]  
11/08: 33 – Molecular Evolution : convergence and constraints [Chs. 9 & 10]  
11/10: **VETERANS DAY -- NO CLASS**

## **VII. Adaptation, Development and evolution**

- 11/13: 34 – Relationships between Developmental and Evolutionary Biology [Ch. 10] **Second writing assignment due in class.**  
11/15: 35 – Adaptive Evolution: from genes to traits [Ch. 10]  
11/17: 36 – Adaptation and Co-evolution [Ch. 15]

## **IX. Human evolution, sex, and behavior**

- 11/20: 37 – Allometry, heterochrony, development, and macroevolution; coevolution. [Ch. 15]  
11/22 & 11/24: **THANKSGIVING HOLIDAY (no class)**  
11/27: 38 – Evolution of behavior – Altruism, kin selection, group selection, ethics and morals. [Ch. 16]  
11/29: 39 – Sexual selection and the hierarchy of social behavior concepts. [Ch. 11]  
12/01: 40 – Human Evolution; genetic structure and history of human populations. [Ch. 17 & pp. 281-283]  
  
12/8: Summary and review of the course; informal Q&A in preparation for final.

**FINAL EXAM: Tuesday December 12, 3-6 p.m., location TBA.**

**Please note that THE FINAL IS COMPREHENSIVE. That means questions will come from all parts of the course.**

## COURSE ORGANIZATION

**Communication:** We encourage you to contact us whenever you have questions. Office hours are best, or any mutually convenient time to meet. We do not do long emails or texts, especially before a due date. Phone conversations are possible if you have questions prepared; please send your phone number and some convenient times to call. Between a review session and an exam we do not answer questions.

**Writing assignments:** In addition to your weekly writing assignments in section, there will be two short papers based on readings that will be distributed. More information on these assignments will be given in class and in section. The papers are due *in class* on the dates indicated in the syllabus and late papers will be penalized 10% per day (after class counts as one day). Plagiarism, which includes turning in papers from other classes, will be penalized accordingly and referred to the Student Judicial Office. We are really not kidding about this, because it's important to learn this here, not outside. Information on plagiarism and correct citation of the work of others can also be found on the course and university websites.

**Discussion sections:** These are mandatory and will comprise part of your grade. They are offered Fridays 11-12, 12-1, 1-2, or 2-3. Your GSI will explain the organization of discussion sections with you.

**Grading structure:** There are three midterms (including the final exam), all of which count 25%. The written assignments count another 25%, but this score is multiplied by your section grade; so, for example, if you get 80s on your papers and a 90 in section, your grade for that 25% of the course is 72. Please note that **this course is never graded on a curve**. 70s are Cs, 80s are Bs, 90s are As, etc. Study questions will be made available about a week before each exam. Some slides and other visual materials and references will also be posted on bCourses, as will your discussion assignments.

**Text:** *Evolution: Making Sense of Life*, by Carl Zimmer and Douglas J. Emlen. This text is required. Pages refer to the 2<sup>nd</sup> edition. It will be used explicitly in class, not just as a reference book. We will key readings to most lectures as far as possible. It is highly recommended that you read the assigned material before class. Other readings for lectures will be posted on the bCourses site, as will those for discussion sections.

### How to succeed in this class:

1. Do the readings *before* class. Then you'll know what's going on in class.
2. Form study groups of 4 or 5 people, no more or fewer. Get a good mix of students.
3. Take copious notes in class. You are expected to be able to do this. If you need help, ask us.
4. Come to office hours. If you have a conflict, contact us to set another time. We're happy to meet with you at other times, especially if you bring friends (they don't have to be in the course, just interested). Saying "I can't make your office hours" is not a good excuse.
5. Keep up with things. Many find that it's just as hard to fall behind here as in organic chem.
6. If you have a question, ask. We'll think you're smart, not stupid. We like questions.

## **Class rules:**

1. Use a cell phone, get thrown out of class. Permanently. (Fine to record lectures; leave devices on front console.)
2. Laptops may be used only for taking class notes, and if you want to do that, you have to sit in the first three rows. Shop the web and do your email in cafes; if during class, you will be thrown out of class permanently. Studies have shown that people can't effectively multi-task, even though many think they can. But more importantly, it's annoying to other students when irrelevant screens are flashing all around them, and we honor those complaints.
3. If you will be late to class (and late means after 10:10), please use the back door, not the side/front door, so as not to distract everyone else. You will find that if you don't stop after your previous class to check social media, you'll probably make it on time, unless you're coming from Pimentel or Siberia (let us know if so). And if some day you need to leave class early, please sit near the back and leave that way. Thanks.
4. If a major issue in your personal life comes up and it's causing you to miss class, get behind in assignments, be absent, or lose focus on the class, it is your responsibility to let us know RIGHT AWAY that your studies might be in jeopardy. That is the time when we can help you. After everything craters and your grade tanks, the options are much fewer. We are really happy to help and accommodate, because sometimes stuff happens; but we need to know sooner rather than later.

Thanks to everyone for your cooperation.

**This course is intended to be an intellectual challenge, not one where you only memorize things. Our goal is to develop your knowledge and your analytical skills. We are going to have a cool time and we're delighted you're in our class.**