BIOL 66. First Year Seminar: Evolution and the Science of Life

Fall 2021

Professor Joel Kingsolver (Biology)

Draft Syllabus and Class Schedule (Jul 2021)

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 Office hours: TBD

Overview This first-year seminar examines the roots, ideas, questions and applications of evolutionary biology. The course will combine lectures, class discussions, readings, class projects, and computer software to address these questions: What is evolution, how does it work, and how do we study it? How do we use evolution to address fundamental questions ranging from adaptation, biological diversity and human origins to the evolution of disease, aging, sex and culture?

The seminar is intended for first-year students from any diversity of background and interests, from arts and humanities, social sciences and natural sciences. There are no prerequisites, beyond a high-school level understanding of basic biology and a willingness to learn. The main objectives of the course are:

1) to understand how scientists study evolution, and how the modern sciences of biology and evolution emerged from natural philosophy and natural history during the past four centuries;

2) to understand general processes and patterns in the history of life, with an emphasis on the origins and evolution of humans;

3) to learn the basic mechanisms and principles that cause (or prevent) evolution;

4) to understand the basics of how to read a scientific research article, and how to communicate this science to non-scientific audiences;

5) to apply our evolutionary understanding to fundamental questions about the evolution of extinction, aging, disease, behavior, and culture.

As a seminar on key issues in evolutionary biology, this course will require the active participation of students in classroom discussions, in collaborative research projects, and in out-of-classroom activities, including visits to and assignments based on scientific collections such as the UNC Department of Anthropology's hominin fossil collections. In addition, students will visit several of the research labs at UNC working on evolutionary biology, to get a more hands-on sense of what researchers actually do.

The exercises and assignments for the course will, for the most part, grow out of these activities. Students will gain familiarity with foundational research methods and techniques in evolutionary biology through readings in Carl Zimmer's *The Tangled Bank: An Introduction to Evolution*. These will be supplemented by selected readings (available on Sakai) on the applications of evolution analysis to problems ranging from the evolution of disease and sex to the future of humans and other species in the Anthropocene. Students will be involved in leading some of the discussions of these readings. They will also complete computer simulation labs (from Simbio software) that develop ways of thinking central to evolutionary biology: population thinking (How do characteristics of individuals lead to evolution of populations?); random thinking (How do random processes such as mutation and drift lead to predictable evolutionary patterns?); tree thinking (How do we build and interpret evolutionary trees and use them to make hypotheses and test predictions about evolution?). Finally, students will work collaboratively in small groups on a final class project, that explores some key issue about evolution and generates a presentation for a non-scientific audience.

As a first-year seminar, this course will include the following learning outcomes:

**Learning Outcomes**

1. Connect with a faculty member early in the educational process.
2. Learn intensively among a small cohort of students, during class discussions, group activities, and group projects
3. Analyze and communicate issues associated with the concepts and tools of evolutionary biology, and applying this understanding to wide range of issues including adaptation, biological diversity and human origins to the evolution of disease, aging, sex and culture
4. Produce knowledge through self-directed inquiry and active learning, using the computer lab exercises, field trip activities, peer-reviewing, and group projects.

This course will also meet the NSI (Natural Scientific Investigation) requirements:

Students learn how to make and interpret scientific descriptions and explanations of the natural world, practice the skills of scientific inquiry, and evaluate scientific evidence within the contexts of both scientific communities and society.

**Questions for Students**

1. What rules govern the natural world and how are they discovered, tested, and validated?
2. What is distinctive about the approach to understanding employed in the natural sciences?
3. What challenges are encountered in making measurements of the natural world?
4. What are the limits of investigation in the natural sciences?

**Learning Outcomes**

1. Demonstrate the ability to use scientific knowledge, logic, and imagination to construct and justify scientific claims about phenomena, including validation through rigorous empirical testing. *This will be considered throughout the semester, and demonstrated in the class discussions of the readings and in the two written assignments.*
2. Analyze and apply processes of natural scientific inquiry as dictated by the phenomena and questions at hand. These include generating and testing hypotheses or theories; using logic and creativity to design investigations to test these hypotheses; collecting and interpreting data; making inferences that respect measurement error; building and justifying arguments and explanations; communicating and defending conclusions; revising arguments and conclusions based on new evidence and/or feedback from peers; and synthesizing new knowledge into broader scientific understanding. *These skills will be emphasized throughout the seminar, and are the central focus of the four computer labs.*
3. Evaluate science-related claims and information from popular and/or peer-reviewed sources by examining the relationship between the evidence, arguments, and conclusions presented and by assessing consistency with existing knowledge from valid and reliable scientific sources. *This will be emphasized in the seminar discussions of the additional (non-textbook) readings, and in the final group project and presentation.*
4. Identify, assess, and make informed decisions about ethical issues at the intersections of the sciences and society. *This will be highlighted in a number of topics throughout the semester, including the origins and humans and human diversity; evolution of infectious disease and human health; extinction and biodiversity in the Anthropocene; and the evolution of genes and culture.*

**Recurring Capacities**

Focus capacity classes sustain the **recurring capacities** of inquiry that guide the general education mission. As appropriate to the course’s topic, each class should:

* Pose problems and questions that require systematic thinking about evidence, argument and uncertainty. *This is central to all aspects of the course.*
* Consider its content in the context of human difference between and within societies; the full range of legitimate debate in its field; and/or change over time. *The first four weeks of the course and many of the supplementary readings focus on the historical emergence of evolutionary ideas and of the science of evolutionary biology; weeks 6, 8, and 10 focus on variation and diversity among humans.*
* Require
	+ Writing totaling at least 10 pages in length, or the intellectual equivalent: *Two writing assignments associated with the two museum visits.*
	+ Presenting material to the class, small groups, or the public through oral presentations, webpages, or other means that enable corroboration of fact and argument: Final group project and presentation
	+ Collaborating in pairs or groups to learn, design, solve, create, build, research or similar: weekly class activities, computer labs, and final project

**Course information and policies:**

One textbook, additional readings (posted on Sakai), and four computer labs are required for this course:

Carl Zimmer, *The Tangled Bank: An Introduction to Evolution* (2nd Edition), 2014.

There will be additional required reading assignments posted on Sakai (see the weekly schedule).

4 Simutext labs (*Simbiotic Software*), downloaded and installed on your personal laptop. Details on obtaining these will be provided in the first week of class.

Grading: 40%: the four Simbio labs (10% each)

 10%: lead class discussion

 20%: two short writing assignments (10% each)

 24%: final project and presentation

 15% attendance and participation

The final group presentation, and individual written assessment, is due at the final exam.

Expectations and Honors Code: Students are encouraged to work collaboratively to understanding the readings, on the lab workshops, during the Rare Books and Anthro Museum field trips, and on the final group presentation. Working collaboratively on these activities is an important expectation for everyone. However, students must work individually (without the input of other students) on the on-line quizzes, the writing assignments, and the individual written assessment component of final project. (Given the nature of these assignments, all of these are ‘open book’.) Failure to do so will represent violation of the honor code. Please ask me if you have any questions about this.

Attendance and participation: Regular attendance and active participation is required. No more than 2 absences during the semester are allowed. Late assignments will be penalized except in cases of serious illness, injury, or family emergency. If you anticipate not being able to hand in an assignment on time, please contact me as soon as you can.

**Accessibility:**
UNC facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in difficulties with accessing learning opportunities. All accommodations are coordinated through the Accessibility Resources and Service Office. See the ARS Website for contact information: <https://ars.unc.edu> or email ars@unc.edu.

**BIOLOGY 66: EVOLUTION AND THE SCIENCE OF LIFE**

**Fall semester 2021: Tu & Th 930-1045, GSB 1377**

**Draft Class Schedule (Jul 2021)**

Week Dates Topic

1 19 Aug What is evolution? Why do we care?

 Readings: Zimmer Ch 1

 Obtain and install Simbio software

2 24 Aug How do we study evolution?

 Readings: Zimmer Ch 2

 26 Aug Evidence for evolution

 Readings: TBD

 Class exercise: EvoEvidence lab (Simutext)

 Class Discussion #0

3 31 Aug Fossils and a brief history of life

 Reading: Zimmer Ch 3

 2 Sep Trees of life

 **Due: EvoEvidence on-line quiz**

 Reading: Zimmer Ch 4, pp 73-90

 Class exercise: Flowers and Trees lab (Simutext)

4 7 Sep Great apes

 Reading: Zimmer Ch 4, pp 90-98; and Ch 14, pp 361-376

 9 Sep: Humans and other hominins

 Reading: TBD

 Class Discussion #1

5 14 Sep Understanding mutation and genetic variation

 Reading: Ch 5

 **Due: Flowers on-line quiz**

 16 Sep Mechanisms of evolution: mutation and selection

 Reading: Zimmer Ch 6

 Class exercise: Sickle cell lab (Simutext)

6 21 Sep Selection and evolution in action

 Reading: TBD

 Class Discussion #2

 23 Sep Random evolution: What is genetic drift?

 Reading: Zimmer Ch 6

 **Due: Sickle cell on-line quiz**

Class exercise: Ferrets and Genetic bottlenecks

7 28 Sep Drift, variation and molecular evolution

 Reading: Zimmer Ch 7

 30 Sep Discussion of projects

 **Due: Ferrets on-line quiz**

8 5 Oct Evolution of disease

 Reading: Zimmer Ch 15, pp 300-420

 7 Oct Evolution of SARS-CV2

 Reading: TBD

 Class Discussion #3

9 12 Oct Adaptation

 Reading: Zimmer Ch 8

 **Due: Assignment TBD**

14 Oct Sexual selection

 Reading: Zimmer Ch 9

10 19 Oct Evolution of *Homo sapiens*

 Reading: Zimmer Ch 14, pp 370-397

 21 Oct **Fall break**

11 26 Oct Aging and life history

 Reading: Zimmer Ch 15, pp 420-424

 28 Oct Grandmothers; Species, and speciation

 Reading: TBD; Zimmer Ch 10

 Class Discussion #4

12 2 Nov Radiations and extinctions, past and present

 Reading: Zimmer Ch 11

 4 Nov Extinctions and human history

 Reading: Zimmer Ch 11

 Class Discussion #5

13 9 Nov work on projects (in class)

 **Due: Assignment TBD**

 11 Nov Co-operation and conflict in evolution

 Reading: Zimmer Ch 12

14 16 Nov Co-evolution of genes and culture

 Reading: TBD

 Class Discussion #6

 18 Nov People’s Choice

 Reading: TBD

15 23 Nov work on projects

 25 Nov **Thanksgiving break**

16 30 Nov submit final project

 **Due: Project write-up**

**xx Dec (xxx) Project presentations & discussions**