

The History of the Science of Life: BIOL/ENGL 089

Fall 2019

Professors Joel Kingsolver (Biology) and Jessica Wolfe (English)

Doctoral mentors: Elizabeth Moore (Biology) and Margaret Maurer (English)

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Overview This interdisciplinary, integrated seminar examines central ideas and questions in the field of evolutionary biology from both contemporary and historical perspectives. How did biological theories concerning mutation, adaptation and selection, extinction and the fossil record, genetic inheritance, altruism, and evolutionary design grow out of the diverse traditions of natural philosophy and natural history that reach back to Aristotle, through the seventeenth-century advances and discoveries of Francis Bacon and the Royal Society, and to pioneers in evolutionary biology such as Georges Cuvier and Charles Darwin? This course examines classic texts in the history of the biological sciences, with an eye to the development of new instruments, as well as new methods and practices of illustration, modeling, and data collection, alongside current knowledge and practice in the field of evolutionary biology, situating recent discoveries and debates in broader scientific and intellectual contexts in order to reveal how advances in the field have grown from, and continue to be informed by, a long and variegated scientific tradition concerned with the design, structure and purpose, and diversity of living organisms.

“There is grandeur in this view of life ... [that] from so simple a beginning, endless forms most beautiful and most wonderful have been, and are being, evolved.” So concludes Charles Darwin's *Origin of Species*, a work that marks the beginning of modern evolutionary biology but also a work informed throughout by pre-modern questions about, and attitudes toward, the natural world. Although not focused on Darwin, this course will examine evolutionary theory and related questions in the biological sciences on both sides of the Darwinian divide, from its origins in the biological writings of Aristotle to the explosion of discoveries and questions concerning biological diversity that accompanied the age of exploration (ca. 1450-1700), to the development of natural history as a discipline, in particular the rise of natural history museums and collections as repositories for scientific discoveries and as institutions that nurtured the intellectual transformation of evolutionary biology in the 19th and 20th centuries. In the process, students will learn how both

biologists and historians of biology account for great discoveries in, and transformations of, scientific thought, from new ways of imagining and representing the natural world, to new methods of and instruments for collecting, examining, and analyzing data.

As an interdisciplinary seminar that offers two complementary perspectives on key issues in evolutionary biology, this course will foreground the active participation of students in classroom discussions, in collaborative research projects, and in a number of out-of-classroom activities, including visits to natural history collections and museums such as the North Carolina Museum of Natural Sciences and the UNC Department of Anthropology's hominin fossil collections, and activities and assignments based on the early science holdings of UNC's Rare Books and North Carolina 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 hands-on activities. On the more scientific side of the course, 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*. They will also complete computer simulation labs (Simutexte) 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?). They will also learn to read and analyze a scientific research article—the fundamental mechanism by which new research is evaluated and communicated to the scientific community. The historical dimension of the course will be enriched through supplementary readings [see syllabus for details] and also through essay assignments and accompanying oral presentations that, in addition to building students' skills of written and oral communication, will allow students to research questions ranging from how early modern naturalists made scientific sense of the bewildering diversity of nature in the newly 'discovered' new world, to the central role that developments in the visual illustration or representation of natural organisms and evolutionary processes played in the advancement of evolutionary biology as a discipline (the second of these assignments will follow a visit to UNC Rare Books). With an eye to the problem (at once historical and contemporary) that scientific theories enjoy often greater "success" if rendered persuasively and intelligibly to a non-scientific audience, the final project for the class will involve designing an 'exhibit' (broadly defined) that illustrates some key issue about the history and science of life.

Schedule of Readings and Assignments

Week 1: Aug 20 & 22. Studying life: an introduction. Whales: myths, monsters, marvels.

Readings: Zimmer, *The Tangled Bank*, Chapter 1: Walking Whales - Introducing Evolution

In coursepack: Aristotle, *History of Animals*, ed. Barnes, Book 8, chap. 2 (pp. 923-24); Olaus Magnus, *A Compendious History of the Goths, Swedes, & Vandals, and other northern nations* (London, 1658), Book 21 ("Of Monstrous Fishes"), Preface, Chap. 1 (pp. 222-223), chaps. 5-9 (pp. 225-227), and look at the illustrations from Joseph Nigg's *Sea Monsters*, pp. 104-111.

Week 2: Aug 27 & 29. Natural history and the emergence of science.

Readings: Zimmer, Chapter 2: Before and after Darwin

In coursepack: Paula Findlen, "Natural History," in *The Cambridge History of Science*, vol. 3. Ed. K. Park and L. Daston (Cambridge UP, 2006), pp. 435-68

Week 3, Sept 3 & 5: Geography, Geology, and Fossils in the history of life.

Readings: Zimmer, Chapter 3: What the Rocks Say

In coursepack: Nicolaus Steno, *The prodromus to a dissertation concerning solids naturally contained within solids* (London, 1671), pp 7-8; pp. 87-96 and Charles Lyell, *Principles of Geology*, Book 1, chap. 5, pp. 26-35, ed. James A. Secord (Penguin, 1997).

Class exercise: Simutext lab 1 (Evolutionary Evidence): due in class, Thursday Sept. 5

Week 4, Sept 10 & 12: The order of organisms: chains, ladders, and evolutionary trees

Readings: Zimmer, Chapter 4: The tree of life (pp 73-90 only)

In coursepack: Alfred Crosby, *The Columbian Exchange*, chap. 3 ("Old World Plants and Animals in the New World"), pp. 64-74 and 106-121.

Class exercise: Simutext lab 2 (Flowers and Trees)

Lab 1 (Evolutionary Evidence) due in class Thursday, Sep 12

Week 5, Sept 17 & 19: Darwin's mechanism: natural selection. What is natural selection, how does it work, and what does it do?

Readings: Zimmer, Chapter 6 (pp 136-147); and Chapter 5: Evolution's Raw Materials

In coursepack: Charles Darwin, *Origin of Species* (1859), chap 4, pp. 63-68, chap. 6, pp. 129-40, ed. Gillian Beer (Oxford World's Classics, 1996; rev. edn 2008)

Class exercise: Simutext lab 3 (Darwinian Snails)

Lab 2 (Flowers and Trees) due in class Thursday, Sep 19

Week 6, Sept 24 & 26: Inheritance: mutants, genes, and genetic variation

Readings: Zimmer, Chapter 6 (pp 125-139 & 146-159)

In coursepack: Amboise Paré, *Of Monsters and Marvels*, trans. Janis Palister (U. Chicago Press, 1982) preface and chap. 1 (pp. 3-4), chap. 8 (pp. 33-37), chaps. 11-13 (pp. 43-47), chap. 20 (pp. 67-73), and chap. 36 (pp. 136-141) and Surekha Davies, chap. 5 ("Monstrous Ontology and Environmental Thinking") of her pp. 148-182 of her *Renaissance Ethnography and the Invention of the Human: New Worlds, Maps, and Monsters* (Cambridge UP, 2016)

Lab 3 (Darwinian Snails) due in class, Tuesday Sep 24

Note: our class on Thurs. Sept. 26 will meet in the lobby of Wilson Library, for a class session in the Rare Book library. Go up the main outside steps and look for our group just inside the building to the right.

Week 7, Oct 1 & 3: Design, perfection, and adaptation: how do complex adaptations evolve?

Readings: Zimmer, Chapter 8: Adaptation - the Birth of the New.

In coursepack: Aristotle, *History of Animals*, Book 1, chap. 1 (pp. 774-778) and Book 2, chap. 1 (pp. 792-797), and *Parts of Animals*, Book 1, chap. 1 (pp. 994-97) and Book 2, chaps. 10-13 (pp. 1021-25), in *Complete Works of Aristotle*, ed. Barnes, vol. 1 and Charles Lyell, *Principles of Geology*, Book 2, chap. 1, pp. 183-95, ed. Second (Penguin)

Week 8, Oct 8 & 10: Races, species, and speciation

Readings: Zimmer, Chapter 10: Darwin's First Question: the Origin of Species

In coursepack: Thomas Browne, *Pseudodoxia Epidemica*, Book 6, chapter 10 ("Of the Blacknesse of Negroes"), pp. 430-440 + notes (pp. 883-84) in *21st-Century Oxford Authors: Thomas Browne*, ed. Kevin Killeen (Oxford UP, 2016) and David Bindman, *Ape to Apollo: Aesthetics and the Idea of Race in the 18th Century* (London: Reaktion Books, 2002), Introduction (pp. 11-21) and Chapter 1 ("Human Variety Before Race"), pp. 23-28 and pp. 58-70.

DUE THURS. OCT. 10: brief writing assignment based on visit to Rare Books on 9/26/

October 12 (Saturday, 800a-12n): field trip to NS Museum of Natural Sciences
We will leave UNC at 800a for the trip to Raleigh. Details to follow.

Week 9, Oct. 15

Writing workshop and discussion of final projects (no assigned readings)

Week 10, Oct 22 & 24: Great Apes and the evolution of humans

Readings: Zimmer, Chapter 4 (pp. 90-98) and Chapter 14 (pp. 361-386)

In coursepack: Edward Tyson, *Orang-Outang, sive, Homo Sylvestris, or, The anatomy of a pygmy compared with that of a monkey, an ape, and a man* (London, 1699), title page and pp. 1-13.

Week 11, Oct 29 & 31: Extinction

Readings: Zimmer, chapter 11: Macroevolution: Life over the Long Run

In coursepack: Lyell, *Principles of Geology*, ed. Secord, Book 2, chap. 9, pp. 270-75; chap. 10, pp. 286-91; Darwin, *Origin of Species*, ed. Beer, chap. 10, pp. 230-37 (on extinction); David Quammen, *The Song of the Dodo: Island biogeography in an age of extinction* (London, 1996), pp. 263-275 (sections 72-77).

DUE Thurs. Oct. 31. Brief (2-3pp) writing assignment based on visit to NC Museum on Oct. 12. More details will be provided in early October.

Week 12, Nov 5 & 7: Sex, mating and selfishness

Readings: Zimmer, Chapter 9: Sex and family (pp 213-228) and Ch 13 (pp 347-357)

In coursepack: Aristotle, *History of Animals*, Book 9, chap. 40 (ed. Barnes, vol. 1, pp. 970-76) and Thomas Moffett, *The Theater of Insects; or lesser living creatures*, Book 1, chap. 3 ("Of the Creation, Generation, and Propagation of Bees"), pp. 897-902 of Edward Topsell, *The history of four-footed beasts and serpents* (London, 1658)

Week 13, Nov 19 & 21: Infection, disease, pestilence, and coevolution

Readings: Zimmer, Chapter 15: Evolutionary Medicine (pp 399-420)

In coursepack: Girolamo Fracastoro, *Syphilis* (1530), ed. and trans. Geoffrey Eataugh (Liverpool, 1984), pp. 43-57 (Book 1, lines 80-381) and Alfred Crosby, *The Columbian Exchange: Biological and Cultural Consequences of 1492* (1973; rpt. 2003), chap. 2 ("Conquistador y Pestilencia"), pp. 35-63.

Week 14, Nov 26: Symbiosis and the web of life

Readings: Zimmer, Chapter 12: Intimate Partnerships

In coursepack: Aristotle, *History of Animals*, Book 5, chaps. 31-32 (ed. Barnes, pp. 877-79); Aelian, *On Animals* 7.19-29, in *On the Characteristics of Animals* (Loeb Classical Library, ed. Scholfield), vol. 2, pp. 127-143; Michel de Montaigne, selection from *Apology for Raymond Sebond*, in *Complete Works*, trans. Donald Frame

Week 15, Dec 3: Aging, death and the life cycle

Readings: Zimmer, Ch 9 (pp 228-241) and Ch 15 (pp 420-429)

In coursepack: Francis Bacon, *The History of Life and Death* (London, 1638), pp. 54-67; William Harvey, *Anatomical exercitutions concerning the generation of living creatures* (London, 1653), images 21, 22, and 23; and Jan Swammerdam, *The Book of Nature*, trans. Thomas Flloyd (London, 1758), Part 2, pp. 18-21 ("In what manner the

Aurelia assumes the form of a Butterfly") and Part 2, pp. 24-28 ("An Animal in an Animal; or the Butterfly hidden in the Caterpillar").

Final presentations: Thursday December 12, noon to 3pm (normally scheduled exam)

Course information and policies:

There are two required books and three computer labs for this course:

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

CoursePack (sold at UNC stores)

3 Simutext labs (Simbiotic Software), downloaded and installed on your personal laptop. Details on first week of class.

Labs, Writing Assignments, and grading

3 Simutext labs

Lab 1 (Evolutionary Evidence) due Sep 12

Lab 2 (Flowers and Trees) due Sep 19

Lab 3 (Darwinian Snails) due Sep 24

2 short writing assignments

Rare Books assignment due Oct 10

NC Museum assignment due Oct 31

1 final group presentation, due Dec 12

Attendance and participation: Regular attendance and active participation is required. All field trips are required. No more than 2 absences during the semester are allowed.

Grading: 10% each for Simutext labs (=30%)

15% each for two short writing assignments (=30%)

30% for final presentation

10% attendance and participation

Doctoral mentors.

In addition to having two instructors of record, this course also involves the participation of two doctoral mentors: Elizabeth Moore (doctoral student in Biology) and Margaret Maurer (doctoral student in English). Their principal role is to mentor students and to assist in the development of assignments; they will also be available for consultation about written assignments and projects, and they will be visiting class on occasion, as well as accompanying the class on field trips. Their contact information is above, at the top of the syllabus.