

Evolution
Biology 350 – Spring 2016
College of Charleston, Department of Biology

Lecture: SSMB 138/140 TuTh 3:05 – 4:20 PM

Instructor: Dr. Matthew (Matt) Rutter

Office: 152 SSMB

Office Phone: 953-7113

Email: rutterm@cofc.edu (this is the best way to get in touch with me)

Note: if you email me from a non-C of C account, it may be filtered as spam

Office hours: Wednesday 11am-noon or by appointment. I will be happy to meet with you—just set up a time!

Student Learning Outcomes: The expected learning outcomes of this course are 1) to obtain familiarity with the phenomenon of evolution and to understand the mechanisms by which it occurs, 2) to explore the importance of ecological, genetic and developmental context in determining patterns of evolutionary change, 3) to investigate the evolutionary history of life on earth, and 4) to examine the application of evolution to biological problems.

This semester we will be examining topics including:

- 1) the patterns generated by evolutionary changes
- 2) the processes causing evolutionary changes
- 3) speciation and phylogenetics
- 4) evolutionary ecology and applied evolution
- 5) evolutionary genomics and evolutionary development
- 6) the history of life on Earth

Much of the class is “cumulative” as many of these topics are interrelated!

Prerequisites: Completion of both Biology 211 and 305. Note: **there is math in this class**, so don't be surprised!

Text: Evolutionary Analysis, 5th edition, Freeman and Herron.

Course Policies

Lecture attendance: A successful student will attend all lectures. I will go BEYOND the text—discussing relevant primary literature and providing additional examples and topics. A prepared student will have read the assigned chapter before coming to lecture.

I welcome questions about the subject matter during lecture. Don't hesitate! I follow the College of Charleston Absence Policy, as described in the student handbook. Did you miss lecture? Get notes and handouts from another student. Exams will come from lecture material in addition to the text.

If you have a planned absence on the day of an exam- you must notify me BEFORE the exam is given. Any make up (with a documented reason) must be completed before I return the graded exams to the rest of the class (no more than 5 days after the exam). All excuses must be documented via the Dean of Undergraduate Study.

Note-taking: Taking notes during an oral presentation, such as a lecture, is an important skill for a student and a scientist. If you miss something in lecture, you are welcome to visit me in my office to discuss and look over slides. I will provide handouts of many critical figures.

Assignments and late policy: For full credit, assignments must be turned in on time. Late assignments will be deducted 5% per school day. Assignments turned in after the assignment is handed back to the rest of the class will not receive credit. Assignments can be turned in directly to me, under my office door at SSMB 152, or in my box in the Biology office on the second floor of SSMB (open 8:30-4pm weekdays).

Computers: Assignments must be typed. There are computer labs for use in SSMB and Addlestone Library.

Courtesy: During class, please turn off (or put in silent mode) cell phones and other devices that make sound. **Please do not talk on the phone, text, IM, browse the web, email, facebook, play Candy Crush, etc. during discussion or lecture.** If you must leave early or arrive late, please sit in back.

Academic honesty: We follow the academic honesty and honor code in this course (see student handbook for details). This policy covers plagiarism, class disruption, courtesy to peers and faculty, including email correspondence. If you have questions about how to properly cite, paraphrase or document literature sources, it is your responsibility to contact me for help.

Lecture Schedule (may change as necessary)

Jan 7 (Th) – **Introductions** – Nothing Makes Sense, Except...– What is Biology 350 All About? – Introductions -- Pestilence as a Useful Illustration
Readings: Ch 1

Jan 12 (Tu) – **HIV** - HIV basics – Death, disease, and HIV – Why does HIV become resistant? – Why does HIV kill? – Susceptibilities
Readings: Ch 1

Jan 14 (Th) **The Origin of an idea** –Darwin, Not in a Vacuum -- Darwin, Darwin and Wallace – The two big ideas -- Evidence at Many Scales
Readings: Ch 2

Jan 19 (Tu) – **Introduction to Natural Selection** – Check your intuition – The Three (or 4) Necessities – Sure you vary, but do you inherit? – What does it take to be fit? – Experimental Detection (Is A Lot of Work) -- Finches, Finches, Finches, Darwin, Grant and Grant
Readings: Ch 3

Jan 21 (Th) –**Selection and Phylogeny Introduction** – Selection can't do everything – Tree thinking – Phylogeny 101 -- How To Read a Tree – Homology and Homoplasy
Readings: Chapters 3, 4

Jan 26 (Tu) **Phylogeny and Simple Genetics** – Phylogenies and inference – Genes and alleles – What does genetic variation look like?
Readings: Chapters 4, 5

Jan 28 (Th) **Mutations and Hardy-Weinberg** – Where all alleles are from -- A Bestiary of Mutants – Mutation Accumulation -- Duplications – Mutation rates and traits -- Focus on the Population -- What Happens When Nothing is Happening – Assumptions and Violations -- Deviating from Hardy-Weinberg
Readings: Ch 5, 6

Feb 2 (Tu) **Evolutionary Processes**— The Four Horsemen of Evolution: Selection, Mutation, Migration and Drift -- A Mathematical Outcome – Selection and Hardy-Weinberg -- Selection and Mutation Changing Phenotypes -- Mutation and Hardy-Weinberg – Mutants and Consequences
Readings: Ch 7

Feb 4 (Th) **Return to Selection** - Artificial Selection, The Civilized World Thanks You – What Darwin Noticed -- Pleiotropy and Correlations –What's the Frequency?
Readings: Ch 6, 7

Feb 9 (Tu) **Sexual Selection and Nonrandom mating** – Boys and Girls, Looking Different – Competing Males – Choosy Females – Runaway! Heterosis, Dominance, and Other Wrinkles What Nonrandom Mating Can Do – Inbred and Depressed About It – Plants are Weird
Readings: 11

Feb 11 (Th) **EXAM I**

Feb 16 (Tu) **Gene Flow and Genetic Drift** --- Migration Makes Everything the Same – Migration Vs. Selection -- What is Random? Drifting beans -- The Smaller, The Driftier
Readings: Ch 7

Feb 18 (Th) **Genetic Drift and Neutral Theory** -- What Happened to the Heterozygotes – Effective Populations – Neutral Theory – Neutrality in the Molecular Genetic Age The Model Doesn't Fit – Ohta's Insight

Readings: Ch 7

Feb 23 (Tu) **The Evolution of Quantitative Characters** – Characters can be complex – Linkage Disequilibrium – The Landscape of Adaptation
Breaking down the Variance – Meet QTLs -- The Breeder's Equation – Fisher's Fundamental Theorem -- Directional, Stabilized and Disrupted

Readings: Ch 9

Feb 25 (Th) **Genome Evolution** – Surprises from sequencing – Is bigger better? – The smallest: viruses – The mid-size: prokaryotes – How do the eukaryotes do it? – Selection from a sequence?

Readings: Ch 15

Mar 1 (Tu) **Species and Speciation** – Everyone Knows the BSC. Nobody Likes the BSC. – New Ideas – Allopatry and Vicariance – Sympatry – Drifting Apart – Selected to Differ – Mutants Apart – Hybrids

Readings: Ch 16

Mar 3 (Th) **Speciation** – More on Hybrids – Sticklebacks and Cichlids – Aphids – Other Examples

Readings: Ch 16

March 7-11 **SPRING BREAK**

Mar 15 (Tu) **The Evolution of Sex** – Linked To Sex – Deducing Evolution and History From Linkage -- Sex Has Its Costs – Recombining -- Muller's Ratchet – The Environment Changes

Readings: Ch 8

Mar 17 (Th) **Coevolution: Competition, Predation and Herbivory**– The End of Competition – Ecological Release -- Kill Your Prey, If You Can Catch Them -- The Joys of Tasting Bad – Arms Races -- Should you specialize? – Manifold defenses – Congruent Phylogenies

Readings: None

Mar 22 (Tu) **Parasitism and Mutualism**– Genes for Genes – Avoid the Virulent More than 2 species— When It's Good to Be Good – A Prisoner's Dilemma --

Readings: Ch 14

Mar 24 (Th) **EXAM II**

Mar 29 (Tu) **Altruism, Eusociality and the Evolution of Behavior** –Close Relatives – Social vs. Sociality -- Oh, Behave
Readings: Chapter 12

Mar 31 (Th) **Senescence and the Evolution of Development** –We Get Old and Die. Why? – Life Histories – Live Fast, Die Young? – Bad Mutants – Tradeoffs, Tradeoffs – Costs of Reproduction – Evolution Shapes Development and Vice Versa – Homeotic Genes and Deep Plans – Of Eyes and Limbs – Flowers
Readings: Ch 13, 19

Apr 5 (Tu) **Human Disease and Applied Evolution** –Flu – Birds and Pigs And Man –HIV – Antibiotic Resistance – Cancer – Sickle Cell – Fever – Mad Cow and Weird Things -- Discouraging Resistance – Tracking Disease and Criminals – Directed Evolution
Readings: Ch 14

Apr 7 (Th) **Origins of Life** – What We Don't Know – RNA World – My Name Is LUCA – Experiments and Inferences About Early Earth – What Does The Phylogeny Say?
Readings: Ch 17

Apr 12 (Tu) **Precambrian Evolution, the Cambrian Explosion and the Invasion of Land** – Single Cells – The Oxygen Revolution – Endosymbiosis – Early Animals And Plants – Burgess Shale – Punctuated Equilibrium-- Gondwana – Ordovician, Silurian, Devonian – Plants and Animals Storm Out of the Water – The Carbon Swamps and the Permian Extinction
Readings: Ch 17, 18

Apr 14 (Th) **From Dinosaurs to Recent History** -- Drifting Continents – Gymnosperms, Deserts and Dinosaurs – Triassic, Jurassic, Cretaceous – The Upstarts: Mammals, Birds and Flowers -- Horses – Primates, Monkeys, Apes and Humans – Ice Ages – Behavior and Culture
Readings: Ch 18, 20

NO CLASS APR 19 (Date of skipped class may change, depending on timing of an experiment in France!)

Apr 22 (F) **Reading Day**

Apr 28 (Thu) FINAL EXAM 12-3pm SSM 138/140

COURSE REQUIREMENTS AND GRADE CALCULATION

- Two in class exams: 300 Pts.
- Final exam (final part of course plus cumulative material): 200 Pts.
- Darwin Week Report (details later) 30 Pts.
- Evolutionary literature 1 (Origin of Species) 30 Pts.
- Evolutionary literature 2 30 Pts.
- Evolutionary literature 3 30 Pts.
- Evolutionary literature 4 30 Pts.
- **Total Points:** 650

Grades: A: 92.5% and up

A-: 89.5% - 92.4%

B+: 86.5% - 89.4%

B: 82.5% - 86.4%

B-: 79.5% - 82.4%

C+: 76.5% - 79.4%

C: 72.5% - 76.4%

C-: 69.5% - 72.4%

D+: 66.5% - 69.4%

D: 62.5% - 66.4%

D-: 59.5% - 62.4%

F: 59.4% and below

Other aspects of grading follow C of C standards.

Last day to drop with grade of "W" is March 25

