

Principles of Evolutionary Biology
BIO 6023, Spring 2018

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Textbook: *Evolution*, 3rd Edition, by Douglas. The textbook is required, but there are three options for the textbook now. You can buy or rent a traditional text (ISBN 978-1605351155), an unbound 3-hole-punch version (ISBN 978-1605351643), or you can buy or rent an eBook. There are also some supplementary materials available online (<http://sites.sinauer.com/evolution3e/>).

Course Description: We will be covering the historical development of evolutionary theory, phylogenetics and systematics, the history of organic evolution, the nature of variation among individuals within populations, and the mechanics of the different agents of evolution and speciation.

Course Information

Prerequisites: If you have not successfully completed introductory biology courses, and genetics you are likely to struggle in this course. You should also be comfortable with algebra, and basic statistics would be helpful. It is preferred that students have taken BIO 6013 or an equivalent course on genetics.

Quizzes and Exams: Each week there will be either an exam or a quiz, never are both required. Quizzes and exams are closed book, and you may not receive help from others. You may only use a calculator when it is explicitly stated on an exercise quiz or exam. Quizzes have a 30-minute time limit, and you will have a full hour for regular exams. The time limit allowed for the final may be greater. Quizzes and exams will be made available at 8 a.m. on Friday mornings, and will become closed at 6 p.m. on Sunday evenings. In total, there are 11 mandatory quizzes, and two optional quizzes. Only the 10 highest quiz scores will be used in the calculation of final grades. There will be three regular exams during the course of the semester in addition to a final exam. The format for quizzes and exams will be mixed and may include, but not be limited to, multiple-choice, true/false, and short answer questions. Questions will be taken from material covered in the course materials, and from accompanying readings. The final exam will cover material from the lectures after Exam #3, and ~ 1/2 of the material will be comprehensive.

Unattempted quizzes and exams A grade of zero will be assigned if students fail to complete a quiz or an exam within the specified timeframe. Under EXCEPTIONAL circumstances a grade substitute may be arranged IF appropriate documentation is provided. If I know in advance that you will likely miss an exam, your chances of negotiating a happy outcome will be greatly enhanced.

BIO 6023, Spring 2018

Grading: Grades will be based on exams, and quizzes. Any exercises posted on MyCourses are for practice, and are made available for student self-assessment. However, I highly recommend completing these prior to taking quizzes and exams. This is especially advisable when mathematical concepts are being covered. Questions on graded material will reflect these exercises.

Final Grade Calculation

Regular Exams	3 X 15% each	45%
Final Exam		25%
Quizzes		30%

Course Schedule: Modules will be released on, or slightly before, the date listed. Modules will also remain available for the remainder of the course. Dates for assessments refer to the release and closing dates for the assessments. It is intended that assessments will be available from 8 a.m. on their release date until 6 p.m. on the closing date.

January 8 Three Modules Released

History and Philosophy of Science 01PhilSci

What is Science? What are Natural Laws? How do we infer Natural Laws?
Deductivism, Inductivism, Hypothetico-deductivism and the Scientific Method
Online Reading Assigned:

http://earthweb.ess.washington.edu/roe/Knowability_590/Week2/Myths%20of%20Science.pdf

Optional Readings:

<http://www.indiana.edu/%7Eensiweb/natscimn.html>

This History of Evolutionary Thought 02HistEvol (Chapter 1, pp. 1-10)

All textbook readings are assigned

Evolution before Darwin

Darwin, Wallace and “The Greatest Idea in the History of Thought”

Blending Inheritance and “The Hole” in Darwin’s Theory

Online Reading Assigned: <http://www.wku.edu/~smithch/wallace/S043.htm>

(The above website will connect you with anything you ever wanted to know about Alfred Russell Wallace)

Online Darwin Resources: <http://www.aboutdarwin.com/index.html>

<http://darwin-online.org.uk/>

The Modern Evolutionary Synthesis 03ModSynth (Chapter 1, pp. 10-16)

Mendel and the “Rediscovery”

Mendelian Inheritance vs. Blending Inheritance

The 16 Fundamentals of the Modern Synthesis

Online Mendel Resource: <http://www.mendelweb.org/>

January 12-14

Quiz #1 (Covers Modules 1, 2 and 3)

BIO 6023, Spring 2018

January 15 Three Modules Released

Systematics, Taxonomy and Common Ancestry 04System (Chapter 2, pp.19-32)

Online Reading Assigned:

<http://www.ucmp.berkeley.edu/history/linnaeus.html>

The above link is part of the University of California Museum of Paleontology website.

Organizing Biodiversity

Linnean Taxonomy

Tree Building

http://evolution.berkeley.edu/evolibrary/article/phylogenetics_07

The above link is a helpful tool for understanding tree thinking. It should also make it easier to grasp Darwin's insight regarding the support Linnean Taxonomy lends to evolutionary theory.

Molecular Clocks and Gene Trees 05 MolSyst (Chapter 2 pp. 32-48)

Molecular Data as Character States

Molecular Clocks

Phylogeny vs. Gene Trees

Evolutionary Patterns 06EvolPat (Chapter 3 pp. 51-63)

Evolutionary History vs. Classification

Inferring Evolutionary Change

Lessons from Systematics

January 29-21 Quiz #2 (Covers Modules 4 and 5)

January 22 Three Modules Released

Development, Trends and Adaptive Radiations 07EvoDevo (Chapter 3 pp. 63-74)

Ontogeny

Trends

Radiations

Geology and the Fossil Record 08FosRec (Chapter 4 pp. 77-90)

Fossil Record

Geological Timescale

Origins of Major Taxa

Rise of the Great Apes, Trends, and Rates 09HumOri (Chapter 4 pp. 90-100)

Fossil Apes (including Humans)

Evolutionary Trends

Evolutionary Rates

January 26-28 Quiz #3 (Covers Modules 6, 7 and 8)

BIO 6023, Spring 2018

January 29 Exam Week, Only Two Modules Released

History of Early Life 10HistLife (Chapter 5 pp. 103-117)

Speculation on Life's Origins
Precambrian Life
The Cambrian Explosion
Conquering Land

The Carboniferous to Now 11ModLife (Chapter 5 pp. 117-132)

Paleozoic and Mesozoic Life
The Modern Epochs and the Rise of Mammals
Glaciation and Landscape Ecology

February 2-4 Exam I (Covers Material from Modules 1-9)

February 5 Three Modules Released

Biogeography I 12BioGeoI (Chapter 6 pp. 135-148)

Role in Early Evolutionary Theory
Major Patterns and History
Vicariance vs. Dispersal

Biogeography II 13PhyloGeo (Chapter 6 pp. 148-159)

Phylogeography
Recent Human Evolution
Ecology and the Theory of Island Biogeography

Biodiversity I 14Biodiv (Chapter 7 pp. 161-173)

Estimating Species Richness
Modeling Change in Richness
Actual Rates of Speciation and Extinction

February 9-11 Quiz #4 (Covers Modules 10, 11, and 12)

BIO 6023, Spring 2018

February 12 Three Modules Released

Biodiversity II 15OrigDiv (Chapter 7 pp. 173-185)

Mass Extinctions
Clade Based Variation
The Future of Life

Mutation 16Mutant (Chapter 8 pp. 189-201)

The Basic Genetic Model
Types of Mutations
Genotypic Mutation Rates

Phenotypic Effects of Mutations 17PhenMut (Chapter 8 pp. 202-213)

Mutation and Fitness
Randomness
Recombination
Karyotypic Variation

February 16-18 Quiz #5 (Covers Modules 13, 14, and 15)

February 19 Three Modules Released

Heritable Variation 18HarWei (Chapter 9 pp. 217-230)

Sources of Variation
Basic Population Genetics (Hardy-Weinberg)
Inbreeding (F)

Do Your Problem Sets!

Variation in Nature 19NatVar (Chapter 9 pp. 231-245)

Linkage Disequilibrium
Quantitative Traits
Statistics 101
Components of Quantitative Traits
Additive Genetic Variation and Heritability

Variation Among Populations 20QuantGen (Chapter 9 pp. 245-253)

Molecular Variation in Nature
Patterns
Gene Flow and Allele Frequency Variation (F_{ST})
Variation Among Human Populations

February 23-25 Quiz #6 (Covers Modules 16, 17, and 18)

BIO 6023, Spring 2018
February 26 Exam Week

The Theory of Genetic Drift 21GenDrift (Chapter 10 pp. 257-268)
Sampling Error Card Game
Coalescence
Effective Population Size

The Neutral Theory 22Neutral (Chapter 10 pp. 268-278)
Basic Principles
Support for Neutral Theory
Drift-Migration Equilibrium
Human Evolution and Neutral Theory

March 2-4 Exam #2 (Covers Material from Modules 11-20)

March 5 Three Modules Released

The Nature of Selection 23NatSel (Chapter 11 pp. 281-290)
Adaptation
The Principal of Self-Organization
Experiments Measuring Selection

Levels of Selection and the Nature of Adaptation 24LevSel (Chapter 11 pp. 290-300)
Group Selection
Selfishness and Altruism
Testing Hypothesized Adaptations

Reconciling Mendel with Darwin 25ModSel (Chapter 12 pp. 303-318)
Fitness and Modes of Selection
Modeling Selection

March 9-11 Quiz #7 (Covers Modules 21, 22, and 23)

March 12-16 SPRING BREAK Observed

BIO 6023, Spring 2018

March 19 Three Modules Released

Modeling the Modes of Selection 26ExampSel (Chapter 12 pp. 318-328)

Examples of the Modes of Selection
Doing the Math

Genetic Outcome of Natural Selection 27SelMath (Chapter 12 pp. 328-343)

Conceptualizing the Outcome of Selection
Predicted Genetic Patterns
Following Allele Frequency Changes in Natural Populations

Evolution of the Phenotype 28QTLMap (Chapter 13 pp. 347-357)

What is a Quantitative Trait?
Variance Components
How Many Genes?
Evolution of Quantitative Traits

March 23-25 Quiz #8 (Covers Modules 24, 25, and 26)

March 26 Three Modules This Week

Selection and Quantitative Traits 29PatPhen (Chapter 13 pp. 357-376)

Measuring Selection in Nature
Maintaining Variation and Trade-offs
Reaction Norms

Fitness and Life History 30FitStrat(Chapter 14 pp. 379-398)

Optimality
Game Theory
The Theory of Life History Evolution

Reproductive Strategies and Fitness 31WhySex (Chapter 15 pp. 399-411)

Modes of Reproduction – Why Sex?
Evolution of Reproductive Strategies

March 30-April 1 Quiz #9 (Covers Modules 27, 28, and 29)

April 2 Exam Week, Only Two Modules Released

Sexual Selection 32SexSel (Chapter 15 pp. 411-424)

Survival Strategies as Variable Traits
Evolutionarily Stable Strategies

Conflict 33GameTheory (Chap 16 pp. 427-444)

Familial Conflict
Genetic Conflict

April 6-8 Exam #3 (Covers Material from Modules 22-31)

BIO 6023, Spring 2018

April 9 Three Modules This Week

Hamilton's Rule 34HamRule (Chapter 16 pp. 444-456)

Basics of Conflict
Direct Benefits of Cooperation
Indirect Fitness

The Reality of Species 35RealSpe (Chap 17 pp. 459-472)

Species Concepts and problems
Reproductive Isolation
Species Delimitation

The Genetics of Reproductive Isolation 36RepIso (Chap 17 pp. 472-481)

Genic and Chromosomal Basis for Reproductive Isolation
Is Genetic Data Good for Diagnosing Emergent Species?
Interspecific Hybridization

April 13-15 Quiz #10 (Covers Material from Modules 32, 33, and 34)

April 16 Only Two Modules Released

Allopatric Speciation 37AlloSpe (Chapter 18 pp. 483-499)

Modes of Speciation
Allopatric Speciation
The roles of Selection and Drift

Alternatives to Allopatry 38SymSpe (Chapter 18 pp. 499-511)

Parapatry and Sympatry
Polyploid and Recombinational Speciation
Tempo and Consequences

April 20-22 Quiz #11 (Covers Modules 35, 36, and 37)

BIO 6023, Spring 2018

April 23 Two (Really One and a Half) Modules Released

Coevolution 39Coev (Chapter 19 pp. 513-529)

Predator and Prey

Host and Parasite

Infectious Disease

Mutualisms and Communities 40Coev (Chapter 19 pp. 529-535)

Mutualisms

Competition

Multispecies Interactions

April 26-28 Quiz #12 (Optional Covers Modules 38, 39, and 40)

April 16-29 Quiz #13 (Optional)

April 28-30 Final (Covers All Course Material)

SAMPLE