

## STUDY GUIDE FOR EXAM II - Spring 2017

**REVIEW SESSION WILL BE HELD on Tuesday, March 7 at 5:00pm in Cox 126.**

**The exam will be given on Thursday, March 9 at 5:00pm in Cox 126.**

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**REMEMBER:** This guide is not a substitute for coming to class, taking notes and reading your text. It is merely a general checklist that should help guide you through your readings. Just because I may have missed a detail or two on this study guide doesn't mean it's unimportant. **Understand CONCEPTS and GENERAL FACTS/KNOWLEDGE rather than memorizing details of specific examples meant to illustrate those things.**

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### **Forces that Drive Evolution**

**Know** the five criteria that must be met if a population is NOT to evolve.

**Know** the meaning/significance of: microevolution, macroevolution, random genetic drift, mutation, assortative mating (positive and negative), immigration and emigration, natural selection, adaptive vs. maladaptive vs. neutral traits or mutations

**Know** the various types of reproductive isolating mechanisms, and at what level each operates. (This is old news from Exam I, but you still need to remember it for this one.)

**Remember** in good detail the concept of Hardy-Weinberg equilibrium, and the five factors that can cause a population to evolve.

**Know** how to figure out a Hardy-Weinberg problem and apply the HW equation to a sample population.

**Know** the meaning/significance of: heterozygosity, a population's average heterozygosity,

**Understand** the meaning/significance of different types of mutations, silent mutation, neutral mutation (and why one is not always the other, and vice versa).

**Know** the meaning/significance of: gene, allele, population, deme, gene pool, polymorphism, homozygous, heterozygous, positive and negative assortative mating, the tenets of evolution by natural selection, sexual selection

(be able to distinguish this from non-random (assortative) mating), genetic drift, Founder Effect, Bottleneck effect

**Know** the meaning/significance of: wild type, mutant, forward vs. reverse mutations, mutational equilibrium

**Know** the difference between a physiological adaptation and an evolutionary adaptation.

**Remember** that while natural selection (and the other five HW factors) may occur at the level the individual organism, only *populations* evolve.

**Know** the meaning/significance of: mutation, forward and reverse (reversion) mutations, wild type, exaptation

**Know** the basic principles of the Classical, Balancing Selection, and Neutral Mutation Models of evolution. Be able to recognize examples of each.

**Know** the meaning/significance of: balanced polymorphism, heterozygote advantage, frequency-dependent selection (positive and negative), search image, exaptation

**Know** the meaning/significance of: assortative mating, inbreeding, outbreeding, immigration, emigration, gene flow, hybrid zone, reproductive isolation via hybridization, hybrid speciation

**Understand** the meaning/significance of: directional, disruptive/diversifying and stabilizing selection and be able to recognize examples of each

**Understand** why evolution does not result in "perfect" organisms.

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### **Origin of Species and Macroevolution**

**Be able to distinguish** among the different species concepts, and how each one defines what makes a species.

**Understand** the meaning/significance of: anagenesis (phyletic evolution), cladogenesis (diversifying evolution), adaptive radiation, character displacement, ecological niche (and the effects of niche overlap re: evolution/natural selection), Gause's Law/Competitive Exclusion Principle

**Understand** the mechanisms of allopatric, peripatric, parapatric, and sympatric speciation.

**Know** the meaning/significance of: autopolyploidy, allopolyploidy, hybrid speciation, hybrid zone, introgression,

**Know** how to calculate a fitness coefficient and a selection coefficient, and what these mean.

**Understand** the difference between microevolution and macroevolution/speciation.

**Know** what is meant by: phyletic gradualism vs. punctuated equilibrium; be able to recognize examples of each.

**Know** what is meant by anagenesis, cladogenesis, incipient species, adaptive radiation, character displacement, altruism, group selection, kin selection, individual fitness, inclusive fitness.

**Know** specifically what is meant by adaptive, maladaptive and neutral characters, and what they mean in terms of differential reproduction.

**Understand** why the marmoset and honeybee examples explain the benefits of kin selection, and why a worker bee is better off helping the queen make more sisters than having babies of her own (which she can't, since she's sterile).

**Know** the general meanings of the different species concepts, including: biological, morphological, recognition, cohesion (and cohesive species)

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### **The Genetics of Evolutionary Change**

**Understand** the meaning/significance/differences between: silent mutation, synonymous mutation, neutral mutation, genetic drift, molecular clock, pseudogene, proteome, natural selection vs. neutral evolution, neutral genetic drift (= neutral evolution), positive selection and purifying selection (both are subclasses of natural selection)

**Understand** the significance of silent vs. non-silent mutations in proteome vs. pseudogenes (or non-coding regions), and the significance of silent vs. non-silent mutations in: purifying selection, neutral genetic drift, and positive selection. View the examples shown by the FOXP2 gene (and while you're at it, take a small break and Google FOXP2 for some interesting recent information).

**Understand** the evolutionary significance of gene duplication and gene recruitment.

**Understand** how mutations in the non-coding regions of the genome can have evolutionary effects, and how changes in the intensity of gene expression can affect phenotype (e.g., Galapagos finch beak development)

**Understand** the basic concept of the Molecular Clock.

**Understand** the basic structure of a gene as well as its regulating regions. What might happen when each of these regions mutates? Know what is meant by: Central Dogma, DNA, RNA, transcription factor, codons, start and stop codons, positive and negative control of transcription, apoptosis, genetic toolkit, Hox Genes

**Know** the major differences and homologies between protostome and deuterostome animals

**Understand** how a change in the level of gene expression can result in a significantly changed phenotype without a DNA-sequence mutation (e.g., beak size and shape in Galapagos finches).

**Know** what is meant by convergent evolution, and be able to recognize new examples

**Know** what is meant by "irreducible complexity" Who claims that some biological structures are irreducibly complex?

**Know** the basic components of the vertebrate eye, and be familiar with the earlier photoreceptor structures seen in living vertebrates (and pre-vertebrates) that show us what ancestral eye precursors might have been like.

**Understand** the evolutionary significance of: rod and cone photoreceptors, lens, iris, cornea, retina, rhodopsin, cone pigments, crystallins, serpentine proteins, snake venom precursors and specializations

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### **The History of Life on Earth**

**Know** the meaning/significance of: abiogenesis, coacervate, protobiont, the contributions of Oparin, Miller & Urey, Sutherland, et al.

**Know** the five major past mass extinctions. What was a probable cause of the one that occurred in the Pleistocene? What about the one that's going on now? What was the Oxygen Catastrophe, and what caused it?

**Understand** the meaning/significance of autogenesis, endosymbiosis, horizontal gene transfer. How did these contribute to the evolution of eukaryotic cells?

**Understand** the meaning/significance of: Greenhouse Effect vs. Global Warming, oxidizing atmosphere (and what generated it), coacervate, protobiont, subduction zone, seafloor spreading, plate tectonics, mass extinction, Cambrian explosion

**Know** the criteria that must be met for a something to be considered ALIVE.

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### **Systematics and Taxonomy**

**Know** how to read a basic phylogenetic tree (the branching diagram representing evolutionary history of a particular lineage of organisms) so that you can see the difference between anagenesis and cladogenesis.

(Use the links to the UC Berkeley site, "Evolution 101," to understand these and other terms and processes.)

**Know** the reasons scientific classifications are useful. Know the (subtle) difference between taxonomy and systematics.

**Know** the significance of the work of Carl Linne (a.k.a., *Linnaeus*). What are the basic rules of *Systema naturae*? What is the significance of the ICBN, ICZN? What are the *most basic* rules governing naming of species?

**Know** the meaning/significance of: alpha, beta and gamma taxonomy, taxon, category, rank, common ancestor, outgroup, parsimony, sister taxa, clade, cladogenesis, analogous vs. homologous characters, homoplasy (see page 540-541 of your text), primitive (plesiomorphic) vs. derived (apomorphic) characters; symplesiomorphy vs. synapomorphy, and what the significance/use of these are in constructing phylogenies, outgroup, ingroup.

**Know** the classification hierarchy (Domain, Kingdom, Phylum, etc.), and what is meant by the "most inclusive" and "least inclusive" groups.

**Know** the three aspects of a taxon (name, rank, content) and be able to recognize which is which.

**Understand** the differences between cladistics, phenetics, and classical evolutionary taxonomy. Which system is most widely employed today?

**Know** how to read and understand a cladogram (a phylogenetic tree constructed using cladistic techniques)

**Know** what is meant by parsimony, and be able to recognize a most parsimonious phylogenetic tree from among a selection of several different phylogenies.

**Understand** the role of horizontal gene transfer in evolution (see pages 552-553 of your text).

**Know** what is meant by monophyletic, polyphyletic, and paraphyletic taxonomic groups. Which one should a systematist always seek to construct when classifying organisms?

[Consider the link to the UCMP site on Cladistics to be assigned reading.](#)

[The lab manual chapter on Systematics and Taxonomy \(the second lab you did this semester\) is also a good study guide for this section.](#)