

Biology 204 Study Guide for Midterm 2 Fall 2009

General tips

Know definitions of terms, but, as importantly, know how to apply the relevant concepts to real world situations and examples. Be able to recognize how examples illustrate the main concepts. What are the various predictions, implications, expectations that follow from those concepts? Be able to distinguish among and relate key concepts in real world situations.

Chapter 25: Evolutionary processes

What is “the modern synthesis”? What are a few of the fields/ideas that it ties together? What are some of its key tenets? What is the difference between microevolution and macroevolution? Explain the idea that, in natural selection, individuals are selected, but populations evolve. What is a population and a population gene pool? How would you calculate p and q for a simple one locus, 2 allele system? How would you calculate the probabilities of genotypes in the next generation under H-W equilibrium? What is the basic message of the Hardy-Weinberg Theorem and why is this theorem considered the “baseline” against which evolution is measured? What are the assumptions on which the H-W theorem rests? Be able to calculate allele frequencies, genotype, and phenotype frequencies in multiple generations, both assuming H-W equilibrium and from actual population data (hint: good examples in the book – try it with different initial genotype frequencies). When would you want to do which?

What are five mechanisms that can cause shifts in allele frequencies in populations (i.e., evolution) and how do they work. What are the differences in stabilizing, diversifying/disruptive, and directional selection in terms of how they influence mean trait values and their variance? What are some examples of each? Be able to apply these patterns to new situations. How is sexual selection similar to and different from the other forms of selection mentioned? How does it affect Darwinian fitness? How is sexual selection similar to and different from inbreeding? What are the sampling effect, founder effect and bottleneck effect? How do they influence gene frequencies? How do they relate to conservation of endangered species? How do they relate to adaptive radiations? Darwin’s finches? What role does genetic variation play in evolution? What forces might keep alleles that cause strongly negative symptoms in homozygotes in the population? How does this relate to sickle-cell anemia?

Chapter 26: Speciation

What is the traditional way by which species have been designated and how is that changing? What is the biological species concept? In which situations is it useful and in which not? What is the difference between prezygotic and postzygotic barriers to interspecies mating? What are the pros and cons of the morphospecies and phylogenetic definitions of species? Do these always give the same answer about species’ relatedness? If not, why not?

What is the key process that regulates speciation between two populations? How does it interact with the other microevolutionary processes previously discussed? What is the difference between allopatric speciation and sympatric speciation? How do each of these work? What are ring species? What is adaptive radiation, how does it work, and how does it relate to Darwin’s finches? What are two ways by which sympatric speciation might take place? What is the difference between autopolyploidy and allopolyploidy? What is an example of each? What problem in meiosis can lead to polyploid offspring? How does this relate back to seedless watermelons?

Phylogenies and the History of Life – Chap. 27

What is the difference between anagenesis and cladogenesis? Be able to interpret a phylogeny, including which organisms are most closely related. What are nodes, branches, roots, sister taxa, and outgroups, and how are they used in phylogenies? How do we construct phylogenies? What types of characteristics do we use? What is an ancestral versus derived characteristic? Can characteristics evolve more than once? If so, how might this affect the construction of a phylogeny? Give an example. What are homologous characteristics versus analogous characteristics (homoplasy)? What is parsimony and how is it used in constructing phylogenies? Understand the whale example given in your book, and be able to apply this to new situations as well. What is the difference between monophyletic and paraphyletic (i.e., polyphyletic) groups? How have molecular phylogenies influenced phylogenetic structure for many major groups of organisms in the last several years?

Where do the 3 domains of life line up relative to each other in the ribosomal RNA phylogeny? Why is this surprising? Within the Eukarya, which kingdoms are most closely related to one another (see also the chapter on Protists; note we probably won't get as far as this last question on this test).

What types of organisms are most likely to be fossilized? Why? How do fossils form? What are the four biases of the fossil record and how do these influence our understanding of ancient life?

Be familiar with the timeline of life, including the four major eras and their relative lengths of time. When did the first living organisms appear on earth? When and why did the oxygen revolution occur? When did the major groups (prokaryotes, eukaryotes, multicellular eukaryotes, animals, land plants, fungi) first appear? When did *Homo sapiens* first appear? What is remarkable about the Cambrian explosion? What are "evo-devo", gene duplication, and *Hox* clusters? How are they, and patterns of gene expression, relevant to the Cambrian explosion?

What are adaptive radiations and why do they usually occur? What are some examples (from that section of the lecture and reading, but also examples we have encountered elsewhere)? What's the difference between background extinction rates and mass extinction events? How frequent are the latter? What has caused them in the past and what might be currently causing them? What were the ramifications of the Permian and Cretaceous mass extinctions? How have these extinctions influenced the biodiversity that we see today? How are adaptive radiations and mass extinctions sometimes linked?

Prokaryotes – Chap. 28

What distinguishes a prokaryotic cell from a eukaryotic cell? What are the two domains of prokaryotes? How are Bacteria and Archaea related to each other? What are some general characteristics of Archaea? Where are they found? What are some of the ecological roles of prokaryotes? Think of some examples of different prokaryotes in these roles. What are nitrogen fixation and eutrophication? How are they important in agriculture and in ecology?

What biases arise with using enrichment cultures to study prokaryotes? How has direct sequencing changed our understanding of the evolutionary relationships among prokaryotes? What is one advantage of enrichment culture over direct sequencing? Vice versa?

What are the three basic shapes of prokaryotic cells? What is the difference between gram-positive and gram-negative bacteria? Describe their cell walls. How do bacteria move? Describe the internal structure of bacteria. How much DNA do they have compared to eukaryotes? How are bacteria with specialized membranes similar to some organelles of eukaryotes? What are the different ways prokaryotes reproduce? What is binary fission? What's a plasmid? What are two alternative ways bacteria acquire DNA and how might they account for the wide dispersal of some traits (e.g., photosynthesis) across the prokaryotes?

What are the major classifications of organisms based on their energy and carbon sources? Into which categories do prokaryotes fall? Which groups are present in your Winogradsky column? What is meant by obligate and facultative in terms of oxygen use? How does this relate to events in the PreCambrian era? In what ways are the prokaryotes more biochemically diverse than eukaryotes? How does this relate to their potential usefulness to humans?