

**Study Questions for Exam 2:
Population Genetics, Evolution, and Speciation**
Conservation Biology
Spring 2009

I have tried to be complete here in terms of *concepts* but it is possible that I have missed some. This is intended to give you something to think about and not be an exhaustive study guide. Also please note that this is not a list of terminology – you should know all terms for the reading and class notes. There were also additional topics specifically addressed in study questions for the handouts and for the text readings that you should think about.

I. Population genetics

1. Be sure that you can do the problems. You should know the following: allele (gene) frequency, genotype/phenotype frequency, how to determine whether or not a population is at Hardy-Weinberg equilibrium.
2. If there are two alleles at a particular locus where p = freq (A1) and q = freq (A2), what is the expected frequency (symbolically, in terms of p and q) of A1 homozygotes, A2 homozygotes and heterozygotes if the population is at H-W equilibrium? Be able to explain (like KNP did in class the notion of why any of these values should equal the allele frequency in a H-W population.
3. If there are 5 alleles found at a locus in a particular population, what is the most that will be in any one individual? Why? If we symbolize their frequencies as p , q , r , s , and t , what must their sum equal? Write an equation that will predict the Hardy-Weinberg equilibrium frequencies for all possible genotypes in this population – you need not write an expanded version of this equation – simply an expression that includes all of the allele frequencies raised to the appropriate power will suffice. You must be able to explain why you raised the equation to this power – what is the "biological reason" – hint – it has to do with sex and the haploid/diploid nature of most species.
4. Know the Hardy-Weinberg (H-W) postulates and be able to explain which ones are most likely to cause a population to not be at equilibrium. What is stasis in regard to H-W?

II. Wrightian Evolution

1. If we ignore migration of genotypes, what factors favor genetic drift? What is the relative role of deme size and selective advantage in drift?
2. Assume that a population is broken up into several distinct demes and genetic drift occurs at a specific locus. Is it likely that all populations will fix the same alleles?
3. What is meant by "random walk evolution?" If drift is a chance process, why is the result, given enough time, to fix alleles? Why don't they just keep increasing and decreasing at random without a loss of genetic variation?
4. Does wrightian evolution adapt populations? Does it cause changes in populations?

III. Darwinian Evolution

1. Know the process of darwinian evolution.

2. What are the "threatening" aspects of darwinian to many people? (There are probably two, closely related to each other.) What, if anything, is fundamentally different about natural and artificial selection?
3. What is an adaptation?
4. Explain what is random and what is not in evolution by natural selection.
5. Fitness is, most correctly, a technical term. What does it mean?
6. What two things do you suppose govern the rate of evolution by natural selection?
7. Explain how darwinian evolution can decrease and increase the frequency of an allele (or a more complex heritable trait, for that matter).
8. Can natural selection operate on non-heritable trait and if so, what effect is there on evolution?
9. Do you have to identify the genes that help to develop a trait to show that it is heritable – put another way, is it necessary to identify the actual "gene for a trait" to discuss its evolution?

IV. General Questions About Evolution

1. What is the role of variation in evolution – if heterozygosity is reduced, what happens to the potential for evolution?
2. The phenotype (and genotype) of a population is due to a "mosaic" of random and directed processes. Some of these have to do with history; some are related to adaptation, etc. As completely as possible, discuss the role of chance and direction in evolution and in determining the phenotype of a population.
3. Softball – give a succinct definition of "organic" evolution.

V. Species and Speciation

1. Distinguish between morphological, phylogenetic, and biological species concepts. What are the advantages and disadvantages of each?
2. What notion is common to each of the species definitions that we considered – all use different means to decide what is and what is not a species yet all have one important underlying similarity.
3. Why do species definitions matter in conservation biology and which one has the force of law in the USA?
4. What are the two most common mechanisms of sympatric speciation and in which major group of organisms does this happen most often?
5. Distinguish between sympatric and allopatric speciation. Which is considered the (far) more common mechanism of species formation?
6. What does "gene flow" between populations do?
7. It has recently become appreciated that evolution may move at different rates at different times in a lineage. Darwin believed in gradualism. Does this new understanding pose, as some suggest, that Darwin was wrong about evolution or does it simply reflect a better understanding of genetics and the environment?