***Chapter 23 & 24 Review***

1. Assume a population is in Hardy-Weinberg equilibrium for a given genetic autosomal trait. What proportion of individuals in the population are heterozygous for the gene if the frequency of the recessive allele is 1%?
2. About one child in 2,500 is born with phenylketonuria (an inability to metabolize the amino acid phenylalanine). This is known to be a recessive autosomal trait.
   1. If the population is in Hardy-Weinberg equilibrium for this trait, what is the frequency of the phenylketonuria allele?
   2. What proportion of the population are carriers of the phenylketonuria allele (that is, what proportion are heterozygous)?
3. In purebred Holstein cattle, about one calf in 100 is spotted red rather than black. The trait is autosomal and red is recessive to black.
   1. What is the frequency of the red alleles in the population?
   2. What is the frequency of black homozygous cattle in the population?
   3. What is the frequency of black heterozygous cattle in the population?
4. Assume that the probability of a sex-linked gene for color blindness is 0.09=q. This means that the probability of X chromosomes carrying the color blindness allele is 0.09.
   1. What is the probability of having a color-blind male in the population?
   2. What is the probability of a color-blind female?
5. The ear tuft allele in chickens is autosomal and produces feathered skin projections near the ear on each side of the head. This gene is dominant and is lethal in the homozygous state. In other words, homozygous dominant embryos do not hatch from the egg. Assume that is a population of 6,000 chickens, 2,000 have no tufts and 4,000 have ear tufts. What are the frequencies of the normal versus ear tuft alleles in this population?
6. Scenario: Small island A contains three separate populations of a single species of cherry tree. The seed size varies between trees. That is, some trees produce seeds that are all in the small size ranges, others produce seeds all in the middle size ranges, and others produce seeds in the large size ranges. A small population of mice is introduced to the island. The mice eat cherries and are the only predators on the cherry trees. When the mice eat a cherry, they completely digest it and the pit or seed inside it. The mice choose medium and large seeds and leave the smallest seeds uneaten.\
   1. Is natural selection operating? If no, what does this imply about evolution? If yes, what is the nature of the variation? For example, what characteristics must the variation have for selection to operate on it?
   2. Is there any indication that members of the population(s) differ in fitness? Explain.
   3. Given your answers to parts a and b, what trend should characterize the future behavior or composition of the population(s)?
7. The Galapagos Archipelego consists of a dozen islands all within 64 km of their nearest neighbor. From 1 to 11 of the 13 species of Darwin’s finches live on each island. Many evolutionary biologists believe that if there had been only one island, there would be only one species of finch. This view is supported by the fact that Cocos Island is isolated (by several hundred kilometers of open ocean) from the other islands in the archipelago and only one species of finch is found there.
   1. How does the existence of an archipelago promote speciation? Explain or provide an example.
   2. Is the mode of speciation that occurred on these islands more likely to have been allopatric or sympatric? Explain.
8. Hybrids formed by mating two different species are often incapable of reproducing successfully with each other or with the members of their parent populations. Explain why this is the case. (Hint: Consider what you know about chromosome numbers and meiosis.)
9. Because most hybrids can’t reproduce, their genes (and the genes of their parents) are removed from the population. Only the genes of individuals who breed with members of their own species remain in the population. This implies that there is strong selective advantage for genes that enable individual organisms to recognize members of their own species. Today a wide range of reproductive isolating mechanisms has been identified.

Each of the following scenarios describes a reproductive isolating mechanism. Indicate whether each is a prezygotic or postzygotic isolating mechanism. Explain your answers.

* 1. Crickets use species-specific chirp patterns to identify a mate or their own species.
  2. Two species of butterfly mate where their ranges overlap and produce fertile offspring, but the hybrids are less viable than the parental forms.
  3. Two species of a plant cannot interbreed because their flowers differ in size and shape and require pollination by different species of bee.
  4. Two species of firefly occupy the same prairie and have similar flash patterns, but one is active for a half-hour around sunset while the other doesn’t become active until an hour after sunset.

1. Many of our most successful grain crops arose as hybrids; most are also allopolyploids. These crops can successfully reproduce. Explain.
2. Allele T, for the ability to taste a particular chemical, is dominant over allele t, for the inability to taste the chemical. Four hundred university students were surveyed and 64 were found to be nontasters. Calculate the percentage of heterozygous students. Assume that the population is in H-W equilibrium.
3. A rare disease which is due to a recessive allele (a) that is lethal when homozygous, occurs within a specific population at a frequency of one in a million. How many individuals in a town with a population of 14,000 can be expected to carry this allele?
4. In Caucasian humans, hair straightness or curliness is thought to be governed by a single pair of alleles showing partial dominance. Individuals with straight hair are homozygous for the Is allele, while those with curly hair are homozygous for the Ic allele. Individuals with wavy hair are heterozygous (IsIc). In a population of 1,000 individuals, 245 were found to have straight hair, 393 had curly hair, and 362 had wavy hair. (a) Calculate the allelic frequencies of the Is and Ic alleles.

(b) Is this population in Hardy-Weinberg equilibrium? Justify your answer. Your explanation

should include a chi-square goodness of fit test.