Problem Set #3

Ch. #3, problems 1-3 and 7-9

1. Evolutionary adaptation is the result of the operation of natural selection resulting in evolutionary change. Evolutionary change occurs by the differential survival reproduction of different genotypes (individuals). Put simply, populations evolve whereas individuals live and die. This clearly differs from the more usual sense of adaptation where individuals adjust their behavior in response to changed conditions; this falls under the province of phenotypic plasticity.

2 .

a. The four postulates are, briefly: variation exists, the variation is heritable, survival & reproduction are not equal, and survival and reproduction are not random. In the snapdragon experiment, if there had been no variation, all flowers would have been the same color. If variation had not been heritable, the colors of the best-reproducing plants would not have been passed to their offspring. If there had not been unequal survival and reproduction, all plants would have attracted equal numbers of bees, and produced equal numbers of seeds. If survival and reproduction had been random, some plants would have had more bee visits and produced more seeds than other plants, but the difference would not be related to plant color. In any of these four cases, the snapdragon population would not have evolved.

b. If the four postulates are true, a population is virtually certain to evolve, unless selection is extremely weak and genetic drift is very strong. Since the four postulates are almost always true, virtually all populations are probably evolving today, at least some genetic loci.

3a. There would be a single point, corresponding the parents' and offspring single beak depth values.

3b. The regression of offspring on midparents beak value would be a horizontal line.

3c. The 1978 lines has the same slope but increased average beak depth for parent and offspring compared to the 1976 line,

implying that the degree of resemblance is the same in both years but the average phenotype has changed.

7. Krontiris is invoking "group selection": selection of a trait that is detrimental to the individual carrying the trait, but that is favorable to other members in the group. Unless the individual in question is closely related to other members of the group (kin selection - see chapter 12), this cannot happen. Natural selection eliminates traits that are detrimental to the individual carrying the trait. Even if others in the group would benefit, the trait will quickly be eliminated from the population.

8. Three major objections to Darwin's theory were: there is not enough variability for evolution to continue for very long; new traits would disappear by "blending" with other traits; and, the earth's temperature implies that the earth is too young for evolution to have occurred. These were resolved by the discoveries of mutation, genes, and radioactivity, respectively. The message is that a theory should not be discarded if it cannot answer all questions, especially if it is clearly better than all alternative theories ("better" meaning that it agrees with more data, makes more successful predictions, and has fewer unanswered questions). The unanswered questions should instead be regarded as topics deserving intensive research.

9. The answer is left to the reader.

And the following:

1. Natural selection is sometimes called the survival of the fittest. A common semantic argument against the validity of natural selection is that the argument is circular. The circularity argument suggests those that survive are the fittest, reducing survival of the fittest to "survival of the survivors". What is the conceptual flaw in the circularity argument?

   The flaw is in the argument's treatment of fitness. In our consideration of requirements for evolution of a trait by natural selection, the fourth requirement was that survival

and reproduction must be non-random with respect to the trait of interest. Non-random survival and/or reproduction as a function of the trait value provides an objective measure of fitness of individuals, irrespective of their particular fates.

2. Often we are interested in the evolution of continuous characters which are affected by multiple genes. We are usually ignorant of what these genes are for most traits of interest. How is it possible to study the evolution of traits whose precise genetic basis is unknown?

   The genetic basis for such traits can be inferred from resemblance of offspring to their parents. If one assumes that the only cause of resemblance betwen offspring and parent (relative to unrelated pairs of individuals) is due to shared alleles, the degree of resemblance provides a measure of the proportion of the variation in the trait that is genetically determined. The requirement for evolution by natural selection under this model is that there be at least some resemblance between parent and offspring (heritability is not zero).