POPULATION GENETICS: A QUICK OVERVIEW!

INTRODUCTION: Complete the following questions using the website: http://phschool.com/science/biology_place/labbench/lab8/intro.html

Once you have navigated to the website, go through the screens by clicking the "next" button. Please note that you may have to view some of the provided animations to answer the questions.

1. What are the 5 conditions that must be met in order for a population to stay at Hardy-Weinburg equilibrium?
   a. large breeding population
   b. Random mating
   c. No mutations
   d. No immigration or emigration
   e. No natural selection

2. Why would nature prefer a large breeding population over a smaller one? A large breeding population helps to ensure that chance alone does not disrupt genetic equilibrium. In a small population, only a few copies of a certain allele may exist. If for some chance reason the organisms with that allele do not reproduce successfully, the allelic frequency will change.

3. What is the difference between random mating and assertive mating? Which would nature prefer? In assortative mating, individuals tend to choose mates similar to themselves; for example, large blister beetles tend to choose mates of large size and small blister beetles tend to choose small mates. Though this does not alter allelic frequencies, it results in fewer heterozygous individuals than you would expect in a population where mating is random. Thus, nature prefers random mating.

4. Why does nature like mutations? Mutations change the nature of the gene pool, thus creating genetic diversity. Nature does not want everything to be identical.

5. How does natural selection play a role in equilibrium? In a population at equilibrium, no alleles are selected over other alleles. If selection occurs, those alleles that are selected for will become more common. For example, if resistance to a particular herbicide allows weeds to live in an environment that has been sprayed with that herbicide, the allele for resistance may become more frequent in the population

6. To answer the question about the pigs and black coats: Why can we not tell the frequency of the black coat allele? We need to know how many of the black pigs are homozygous and how many are heterozygous. You cannot know that by simply looking at the picture

7. What is the equation for Hardy-Weinberg? What does p stand for? What does q stand for? p = the frequency of the dominant allele (represented here by A)
q = the frequency of the recessive allele (represented here by a)

For a population in genetic equilibrium:
p + q = 1.0 (The sum of the frequencies of both alleles is 100%.)

$(p + q)^2 = 1$

so $p^2 + 2pq + q^2 = 1$

8. What is the difference between allele frequency and genotypic frequency?
   Genotypic frequency is the frequency of a genotype — homozygous recessive, homozygous dominant, or heterozygous — in a population

9. Solve the following problem: In a certain population of 1000 fruit flies, 320 have sepia eyes while the remainder have red eyes. The sepia eye trait is recessive to red eyes. How many individuals would you expect to be homozygous for red eye color?

1. q^2 for this population is 360/1000 = 0.36

2. $q = \sqrt{0.36} = 0.6$
3. p = 1 - q = 1 - 0.6 = 0.4
4. The homozygous dominant frequency = p^2 = (0.4)(0.4) = 0.16.

Therefore, you can expect 16% of 1000, or 160 individuals, to be homozygous dominant.

Problem: 1 in 1700 US Caucasian newborns have cystic fibrosis. C for normal is dominant over c for cystic fibrosis.

1. When counting the phenotypes in a population why is cc the most significant? It is the easiest to factor since it is the rarer of the three phenotypes.

2. What percent of the above population have cystic fibrosis (cc or q^2)? In order to figure out q2= 1/1700= 0.0005= .05%

Problem 2: If 9% of an African population is born with a severe form of sickle-cell anemia (ss), what percentage of the population will be more resistant to malaria because they are heterozygous(Ss) for the sickle-cell gene?

a. q2= 9%=.09
b. square root of .09= .3
c. so q=.3

d. p + q=1
e. so p= 1-.3=.7
f. 2pq=Ss
g. so 2 (.7)(.3)= .42= 42%

so 42% of population is heterozygous