Genetics and Evolution Problem Set

1. In Varunland, your number of fingers on each hand is a polygenic trait. You have one finger on each hand for each dominant allele of either the A gene or the B gene. Two individuals with the genotypes AaBb have offspring. What proportion of the offspring will have:

0 fingers: _____   1 finger: _____   2 fingers: _____   3 fingers: _____   4 fingers: _____

2. The following statements describe differences between mitosis and meiosis. Which of the statements are true? Select all that apply.

   A. Crossing over only occurs in meiosis
   B. Microtubules, microfilaments, and intermediate filaments are all broken and reformed in meiosis, but at least one type is not used in mitosis
   C. The diploid state in most fungi uses meiosis, but not mitosis
   D. Nondisjunction occurs in meiosis, but not mitosis

3. The inheritance of Tay-sachs disease is often considered to be autosomally recessive. Which of the statements correctly explain why heterozygous individuals show the dominant phenotype?

   A. The enzyme created by the wild-type allele co-activates a protease that targets the mutant enzyme
   B. Though only half of the wild-type enzyme is made, this amount is enough to sufficiently breakdown products that would otherwise accumulate in the brain
   C. Transcription of the wild-type allele inhibits transcription of the mutant allele
   D. DNA polymerase 1 and an endonuclease molecule cut out the nucleotides leading to the mutation and fix them according to the wild type allele

In Varunland, there's a certain genetic disorder called Yilunemia. Relative to homozygous wild-type individuals, heterozygous individuals have a 1/2 chance of survival, and homozygous Yilunemia-afflicted individuals have a 1/4 chance of survival. Currently, 64% of the Varunland's inhabitants are healthy.

4. What is the frequency of the mutant Yilunemia allele?

   A. 0.2
   B. 0.4
   C. 0.6
   D. 0.8

5. What type of inheritance does the Yilunemia condition show?

   A. Complete dominance

B. Incomplete dominance
C. Codominance
D. Epistasis

6. After one generation of selection, what will be the new frequency of the mutant Yilunemia allele?

A. 0.085
B. 0.10
C. 0.11
D. 0.14

7. After the one generation of selection referenced in #6, what percent of the town's inhabitants will be healthy?

A. 84%
B. 81%
C. 79%
D. 74%

Some scientists discover a drug that will eliminate the effects of Yilunemia for heterozygous individuals and give homozygous Yilunemia-affected individuals a 1/2 chance of survival relative to healthy individuals. Currently, 64% of Varunland's inhabitants are healthy (homozygous wild-type allele).

8. Assuming all individuals take the drug, what type of inheritance does Yilunemia now show?

A. Complete dominance
B. Incomplete dominance
C. Codominance
D. Epistasis

9. After one generation of selection, what will be the new frequency of the mutant Yilunemia allele?

A. 0.11
B. 0.18
C. 0.20
D. 0.24

10. After the one generation of selection referenced in #9, what percent of the town's inhabitants will be healthy (homozygous wild-type allele)?

A. 79%