

### Self-Study Problems #3: Molecular and population genetics

1. Fill in the blanks with terms from the list below. Some terms may not be used, or may be used more than once. You may change terms from singular to plural if necessary.

Through the process of \_\_\_\_\_, the sequence of \_\_\_\_\_ in a long segment of \_\_\_\_\_ determines the sequence of \_\_\_\_\_ in a long segment of \_\_\_\_\_, which in turn, through the process of \_\_\_\_\_, determines the sequence of \_\_\_\_\_ in a \_\_\_\_\_.

amino acid, base (or nucleotide base), carbohydrate, catalyst, centromere, chromosome, division (or cell division), meiosis, mitosis, DNA, RNA, mRNA, tRNA, nucleus, protein, reduction, replication, reproduction, ribosome, transcription, translation, transmission

2. Errors occasionally occur in the processes in question 1.
  - a. Are these errors likely to affect the next generation in some way?
  - b. Why or why not?
3. What are the two types of cell division called?
4. What is the overall difference between the two types of cell division?
5. What is the result of crossing over?
6. Why would natural selection be expected to favor organisms that were developing sexual reproduction and crossing over?
7. Mendelian genetics initially seemed to apply only to dichotomous or discrete traits. How can Mendel's model explain continuously variable traits?

8. Explain how two parents that are 5' 8" tall could have a child who grew to 6' 2" tall, even if the environments in which they were raised, their medical care, etc. were all the same. Provide an explanation that routinely occurs in real life, not an extremely unlikely mutation.
  
9. What is a point mutation, and what changes can it cause?
  
10. Define evolution in population genetic terms.
  
11. The dominant H allele results in hitchhiker's thumb; straight thumbs are produced by the recessive s allele. Say that in the whole population, 80% of the alleles are s.
  - a. What fraction of the alleles in the population are H?
  - b. Say we observe a population of 500 males and 500 females (1000 total people). They all form couples and have kids. Assuming that having hitchhiker's thumbs or straight thumbs has no effect on how well one survives, who one mates with, or how many offspring one has, what are the frequencies of each possible genotype among the offspring? Explain with a Punnett square.
  
  - c. Say each couple has two offspring, for a total of 1000 kids. About how many of them would you expect to have straight thumbs? Explain using the equations for Hardy-Weinberg equilibrium.