

**PART 1.**

1. Based on the insulin study we did last week, draw a family tree for: salmon, mice, chicken, human, frog, snake, monkey, rat, turkey and whale. Write a brief essay defending your choices in arranging the tree.
2. Consider 2 traits R and T, each with 2 possible alleles R and r and T and t. Two purebred strains are crossed and the offspring all show the phenotype R and T. When these offspring are testcrossed, the following phenotypic results are obtained: R and T-- 25; R and t-- 95; r and T-- 20; and r and t-- 100.
  - a) Propose an hypothesis to explain these results.
  - b) What are the phenotypes of the original purebred strains?
3. The accompanying graph shows the DNA content per cell in a particular population of cells, whose diploid number is 16, as a function of time,. First, draw on this graph, a line showing the information content per cell, and then, describe what is happening during the labeled segments of the graph and finally, identify the segments, during which variability is increased and describe how that increase occurs.
4. The amino acid sequences encoded by the genes for certain proteins controlling development have been found to be remarkably similar between vertebrates and invertebrates, despite the evolutionary divergence of these animals over 500 million years ago. Speculate on why evolution has been so conservative with these genes.
5. An orange grower discovered that most of his trees were infested with destructive mites. He sprayed the trees with insecticide, which killed 99% of the mites. Five weeks later, most of the trees were infested again, so he sprayed again, using the same quantity of the same insecticide. This time, only about half the mites were killed. Explain why the spray did not work as well the second time.
6. Many species can reproduce either asexually or sexually. It is often when the environment changes in some way that is unfavorable to an existing population that the organisms begin to reproduce sexually. Speculate about the evolutionary significance of this switch from asexual to sexual reproduction.
7. In a random sample of shorthorn cattle, 73 were red (RR), 63 were roan (Rr) and 13 were white (rr). Estimate the allele frequencies of R and r and determine if the population is in agreement with Hardy-Weinberg.
8. Explain why homologous structures are evidence of a common ancestor while analogous structures are not.
9. Some species have been rescued from near extinction by conservationists. In terms of evolutionary theory, what problems do such species face as their populations rebound from a small size.
10. Variation in a population is very important since the environment is always changing. If the individuals are all identical and the environment becomes inhospitable, the species disappears.
  - a. What is the ultimate source of all variability?
  - b. Describe 4 ways in which variability is maintained in populations.
11. Given a population split in two by a canyon. The canyon persists for a very long time. In this allopatric situation, describe how the two populations could diverge enough over time to become

two species, so that if the canyon filled and the two populations were reunited, they would not be able to interbreed.

12. In dogs, black ( $B$ ) is dominant to chestnut ( $b$ ), and solid color ( $S$ ) is dominant to spotted ( $s$ ). What are the genotypes of the parents that would produce a cross with  $3/8$  black solid,  $3/8$  black spotted,  $1/8$  chestnut solid, and  $1/8$  chestnut spotted puppies? (Hint: first determine what genotypes the offspring must have before you deal with the fractions.)
  13. The skin pattern of the common leopard frog is genetically determined. When striped frogs are mated with spotted frogs, all of the offspring are striped. When these striped offspring are crossed, they produced 147 striped and 56 spotted frogs.
    - a. Which pattern is due to a dominant allele?
    - b. How many of the grandkids are expected to be heterozygous?
    - c. How many of the grandkids with the recessive phenotype are expected to be homozygous?
  14. Given a recessive trait that occurs once in every 100 births,
    - a. what is the frequency of the recessive allele
    - b. what fraction of the population is heterozygous?
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## PART 2.

1. Define Natural Selection.
2. The Darwinian fitness of an individual is measured best by \_\_\_\_\_.
3. How many unique gametes could be produced through independent assortment by an individual with the genotype  $Aa BB Cc Dd EE$ ?
4. The outward expression of an organism's genotype is referred to as its \_\_\_\_\_.
5. An individual is said to be \_\_\_\_\_ if it has two copies of the same factor for a given trait.
6. When a gene is carried on one of the sex chromosomes, it is said to be \_\_\_\_\_.
7. A \_\_\_\_\_ is a separate group of organisms incapable of interbreeding with other such groups.
8. Pairs of chromosomes that have the same size, shape, and function are \_\_\_\_\_.
9. An unexpected change in a cell's genetic makeup is called a \_\_\_\_\_.
10. Define: gene
11. Identify 4 possible sources of reproductive isolation:
  - 1
  - 2
  - 3
  - 4

12. In some vertebrates, live young can be produced without fertilization of an egg. The “egg” just begins to develop into an organism. These organisms are diploid like their mother. How might meiosis in the mother's ovary be modified to produce a diploid baby?
13. Over a period of time, the frequency of an allele in a population decreases from 0.01 to 0.003. Offer 3 hypotheses which might explain this change?
- 1
  - 2
  - 3
14. Create a life cycle diagram showing the relationships among the following 4 terms: haploid, diploid, meiosis, and fertilization.
15. What is the evolutionary significance of mutation?
16. In rabbits, the homozygous  $CC$  is normal,  $Cc$  results in rabbits with deformed legs, and  $cc$  is lethal. For a gene for coat color, the genotype  $BB$  produces black,  $Bb$  brown, and  $bb$  a white coat. Give the phenotypic proportions of offspring from a cross of a deformed-leg, brown rabbit with a deformed-leg, white rabbit.
17. List the 3 essential processes that must occur in mitosis and what the products look like.
- 1
  - 2
  - 3
  - 4 The products are\_\_\_\_\_
18. List the processes that must occur in the formation of gametes(eggs or sperm). Start with a resting cell in the gamete producing tissue containing 14 pieces of DNA, also known as chromosomes. Point out the 2 steps which increase the number of different gametes that can be formed.
- 1.
  - 2.
  - 3.
  - 4.
  - 5.
19. A man and woman, both normally pigmented, have an albino child together. The mother is now pregnant for a third time, and her doctor tells her she is carrying fraternal twins. What is the probability that both children will be normally pigmented girls?
20. In a cross between parents who both exhibit the dominant curly- and dark-haired traits, one child has straight, light-colored hair. What is the hair genotype of the parents?

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