Big Idea 1: The process of evolution drives the diversity and unity of life

1. **(B)** Fewer predators upstream means that the population size will increase, but there will be less food for each, so they will grow slowly and larger, reproduce later and less, and die older. The guppies found downstream will reproduce earlier and die younger due to the increased predation. The guppies in the high predation pools will exhibit drab coloration due to the increased predation.

2. The total population size is 231 budgies. In this population, 37/231 budgies are blue in color (0.16 or 16%) and 194/231 budgies are green in color (0.84 or 84%).

   The dominant allele frequency is 0.6. Using the Hardy Weinberg equilibrium equations, $p + q = 1$ and $p^2 + 2pq + q^2 = 1$, we can determine that the percent of the population that is blue (recessive) in color is q^2. This value (q^2) is 0.16. If $p + q + 1$, and $q2 = 0.16$, then the $\sqrt{0.16} = 0.4$, and $q=0.4$. If $q=0.4$, then dominant allele (green color) frequency can be calculated ($0.4 + p = 1$, $p = 0.6$). Therefore, the answer is 0.6

3. **(A)** The disease frequencies are relatively constant over time, based upon the fact that founder populations contained these mutations, and over time, either because they conveyed some form of advantage, or did not cause any reduced fitness, have continued to remain at steady frequencies within the population.

4. **(D)** The number of amino acid differences is indirectly proportional to the relatedness of the species in question. Furthermore, the lower the number of amino acid differences, the more recent of a common ancestry. The cow and dog are separated by 10 amino acid differences, however, the cow and mouse are only separated by 2 amino acid differences. The kangaroo has more amino acid differences (as compared to the human beta chain) than the gorilla. The gray kangaroo and chicken have the same number of amino acid differences as the rhesus monkey and a dog. However, humans have 125 amino acid differences as compared to the lamprey (jawless fish) and 127 differences as compared to the mollusk.

5. **(D)** In stabilizing selection, there is a disadvantage to have variation on one or the other extreme, and the most advantageous position is somewhere in between. In disruptive or diversifying selection, which is the opposite of stabilizing selection, the two extremes in variation are advantageous within the population. In the type of selection described, members of a population at one end of a variation spectrum are selected against, while the other end is selected for. This is the type of selection described in the question, as the dominant color changed from one extreme to another (blue to orange/red) over time.

6. **(B)** The species will not repopulate in the same manner as before the natural disaster. It is unknown how the natural disaster affected the abiotic factors within the ecosystem, which will dramatically affect what organisms can populate the area. The remaining species will either diversify quickly, if the ecosystem is suited to their growth, or possibly become extinct if the environment is not appropriate for their needs.

7. **(B)** H and I are more closely related than G is to H or I. So, reversing the order of G and H would not accurately represent the same relationships as the current phylogeny. If the given organisms are present on the cladograms, earthworms would need to be letter A, as they don't have vertebrae. Earthworms are an annelid (an invertebrate) while lizards and crocodiles are both vertebrates and both reptiles. Lizards and crocodiles are much more closely related than earthworms Species D separated from a common ancestor from species E and species F at the same time. So, neither species E or F is more closely related to D than the other one.

8. **(C)** Bar 1 cannot be a backbone, as earthworms are invertebrates. Node B needs to represent vertebrates, not invertebrates. Bar 2 could represent the presence of a backbone, as goldfish, lizard and elephants are all vertebrates. Node C cannot represent mammals, as lizards are reptiles.

9. **(C)** In Hardy-Weinberg equilibrium, the frequencies of the dominant and recessive alleles will remain constant over time. In this case, while they do equal the value of 1, this does not indicate equilibrium over time. Since the frequency of the recessive allele decreases, the frequency of the homozygous recessive genotype would also decrease. While individuals may have immigrated into the population, this would not cause the graph as observed. This graph does show how selection causes individuals to survive and some to perish, changing the allele frequencies of the population.