Answers to Questions for Comprehension

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Q1. An adaptation is a trait that helps an individual survive. A shark with a keen sense of smell will be better at finding food and will therefore be more likely to survive and produce healthy offspring. These offspring will be more likely to have their parent's keen sense of smell.

Q2. Sexual reproduction takes the gametes from two parents and produces a resultant variant in their offspring. Each offspring gets a different combination of the parents' genetic material, so each offspring will be unique. Sexual reproduction is also influenced by increased variability because of events in meiosis, such as crossing over, that create new genetic combinations. The offspring will always be a variant of its parents.

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Q3. When a student is discussing a mutation that provides a selective advantage, the response should point out that individuals with this advantage will be favoured to produce more offspring for the next generation.

Individuals with a selectively disadvantaged mutation will reproduce less frequently or their offspring will be less likely to survive.

For example, a selective advantage could be one that gives certain individuals within a population increased hunting success. These individuals will be selected for as mates because of this success. Individuals that have other variations that do not promote hunting success will be selected against (survival of the fittest).

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Q4. One example is the beaks on the finches; some finches may have longer beaks and some may have wider beaks. These phenotypic differences were caused by mutations and selective pressures. A second example is drought-resistance in fescue. At one point, individuals within a population had the mutation for drought resistance occur within their genes and it was a heritable trait. Once it was passed on to the next generation because of its reproductive and selective success, it became more and more predominant.

Q5. Insecticide acts as a selective force within the environment. Because of the variations within the population of insects, some will survive the insecticide application. When these individuals reproduce, the next generation will have more individuals that are able to survive because they have inherited the genes necessary for the insecticide resistance. This change in environment, with different selection pressures, is natural selection

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Q6. Cuvier would have suggested the species of fish had become extinct, possibly due to a natural catastrophe such as a flood or volcanic eruption.

Q7. Lyell rejected the idea of catastrophism and guessed that the Earth changed slowly and continuously over time. His idea also suggested that the Earth was older than 6000 years. He believed that slow, continuous change would amount to large changes over time. This influenced other thinkers such as Charles Darwin, who wondered if the same sort of processes and timelines were occurring in populations also.

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Q8. Using Lamarck's hypothesis of inheritance of acquired characteristics, because the farmer's ability to develop dark-tanned skin served a favourable purpose (adaptation) it would be passed onto her offspring. According to Lamarck, the offspring would all be born with darker than normal skin, so that they would have this advantage to begin with and continue possibly getting darker during their lifetime and passing this increased darkness onto their offspring as well.

Students should also indicate that while this would have been a reasonable hypothesis in Lamarck's time, now that scientists understand the distinction of heritable traits and the role of genes, it would no longer be considered.

Q9. Charles Darwin surmised that species could change over time after looking at the tortoises and finches on the Galápagos Islands. When he discovered that the finches had different beaks that allowed them to eat different food, and that the finches whose beaks were different lengths were not interbreeding, he surmised that these were different species, which must have been descended from a common ancestral finch, and which changed slowly over time to adapt to new environments. His observations were also supported by his knowledge of breeding of dogs, pigeons, and flowers. His research here showed that variations could be passed on through sexual reproduction and that many new variations could be produced. This helped emphasize that change could happen within a species over time.

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Q10. Competition for limited resources accounts for the "struggle for existence" part of Darwin's theory of natural selection. Certain members of a species with the better adaptations and variations will out-compete others for the limited resources. Those that are able to out-compete will also be the ones that produce more offspring because of their successful traits.

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Q11. (1) Stratification has shown that most often the fossils found in the younger layers (those closest to the surface) are more similar to the species living today than those found within the older or deeper layers. (2) Another thing the fossil record shows is that not all organisms appear in the fossil record at the same time. For example, by comparing different fossil beds, scientists were able to show that fish are the oldest vertebrate fossil, and in turn, amphibians developed from ancestral fish, reptiles evolved from ancestral amphibians, and mammals and birds both evolved from different groups of reptiles.

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Q12. Bird wings and bat wings are analogous structures. They serve the same function, but birds and bats come from different common ancestors and developed independently of one another.

Q13. Similarities in embryological development point to a common ancestral origin. As the development occurs, similarities such as the paired pharangeal pouches, which develop into gills in fish and amphibians, and ears and throat in humans, show that all vertebrates have a common ancestral origin.

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Q14. Embryology, Molecular Biology, Paleontology, Comparative Anatomy (homologous and analogous structures), and Genetics have contributed to the theory of evolution by natural selection.

Embryology—similarities in development and developmental structures show relatedness to a common ancestor.

Molecular Biology—the presence of similar patterns on different species' DNA shows that the patterns were most likely inherited from a recent common ancestor. The farther apart the similarities, the more distant the common ancestor.

Paleontology—the fossil record shows the progression of species, their extinctions, possible transition species, and the order that they appeared in history.

Comparative anatomy—by examination of structures and bone make-up and functions, scientists can discover if the structures are homologous (which implies a common ancestry, but not necessarily a common function) or analogous (perform the same function, but developed independently of each other).

Genetics—the study of gene sequences has allowed scientists to make discoveries such as the relationship of dogs to bears, and whales to hippopotamuses. The study of the mechanisms of heredity and mutations allows scientists to surmise where and how these events transpired.

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Q16. A bird's call is considered to be a biological barrier that keeps species reproductively isolated. Bird calls are a key part of the mating process, and the distinctive calls of each species of bird ensure that they only mate with members of their own species.

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Q15. Speciation is the formation of a new species. The two pathways that can produce a new species are:
(1) Transformation: Accumulated changes over a long period of time: a new species develops while the ancestral or founder one slowly becomes extinct. (2) Divergence: One or more species arise from the parent species, and the parent species continues to exist, allowing for increased species diversity.

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Q17. The rise and fall of a lake over many thousands of years will create many isolated pockets of water. These will have different environments, within which individuals will have to successfully adapt. Because of the differences in selection, new species can arise because of the geographical isolations. Different selective pressures will eventually create different species.