**Review Worksheet Answers – Evolution by Natural Selection**

1: Give a modern-day definition of natural selection

(2 marks)

*Selection of those alleles (1) in a population that give an organism a greater survival advantage (1) (ie: organisms with alleles that give them an advantage in their environment mean that those organisms survive and reproduce better to pass those alleles on to offspring.*

2: List the 6 principles of evolution through natural selection.

(6 marks)

*There is variation within a population (1)*

*More offspring are produced in the population than survive to maturity (1)*

*Limited resources cause a struggle for existence – there is competition for survival (1)*

*Individuals with characteristics (coded for by genes/alleles) best suited to the environment have Whmore chance of surviving and reproducing – “survival of the fittest.” (1)*

*Characteristics that assist survival are more likely to be passed down to the next generation (1)*

*In the gene pool the proportion of alleles that produce favourable characteristics gradually increases (1)*

3: Use the example of the Peppered Moth to provide evidence of evolution through natural selection using the table below.

(6 marks)

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| **Principle** | **Evidence** |
| There is variation within populations | *Peppered moths carry alleles for light and dark wing colouration (0.5), and show variation in colour within their population. (0.5)* |
| More offspring are produced in the population than survive to maturity. | *Not all moths survive to maturity (0.5). Some may be eaten by predators, some may not have access to enough food, or other factors may kill them before maturity.(0.5)* |
| Limited resources cause a struggle for existence – there is competition for survival. | *Moths must compete for life necessities like food, water, and shelter from the environment and predators. (1)* |
| Individuals with characteristics best suited to the environment have more chance of surviving and reproducing – “survival of the fittest” | *Moths with wing colour that provides the best camouflage (0.5) are less likely to be eaten by predators.(0.5)* |
| Characteristics that assist survival are more likely to be passed down to the next generation | *Moths with wing colour that provides the best camouflage can avoid predators (0.5), and pass on their characteristics to their offspring (0.5)* |
| In the gene pool the proportion of alleles that produced favourable characteristics gradually increases. | *Moths with alleles for wing colour that match the surrounding tree trunks (0.5) survive at a greater rate and pass those alleles on to offspring (0.5).* |

4: Genetic drift is non-directional, whereas Natural Selection is directional. Describe what is meant by this.

(8 marks)

*Non-directional means that the allele frequency (1) for a particular allele doesn’t consistently increase or decrease over time (1). It may increase in one generation, and then decrease in the next (1), due to random chance (1).*

*Directional means that the allele frequency (1) for a particular allele consistently increases (or decreases) over time (1). Generally in this case, there is an environmental factor (1) favouring survival of individuals with the allele (1) in question.*

5: Define speciation

(2 marks)

*The splitting of one species into two separate species (1) due to divergence (separation) of gene pools. (1)*

6: Describe in detail the process involved in speciation.

(10 marks)

*1: Variation (0.5): A range of variations exists within the population (0.5), which shares a common gene pool (0.5).*

2: *Isolation (0.5): A barrier forms dividing the population in two (0.5). Little to no interbreeding is possible between the populations (0.5). Each population now has a separate gene pool (0.5).*

3: *Selection (0.5): Due to environmental differences (0.5) in the areas inhabited by the two populations, different selection pressures (0.5) act over a number of generations (0.5). This brings about a change in the gene frequencies (0.5) of each gene pool (0.5) and therefore the characteristics (0.5) of the population. A sub-species forms (0.5). If the barrier is removed, the two populations will still be able to interbreed (0.5).*

*4: Speciation (0.5): Over a long period of time (0.5), changes in gene frequencies, including via mutation, may be great enough (0.5) to prevent the reproduction between the two populations (0.5), even if the barrier is removed (0.5). When this occurs, the original population has become two different species (0.5).*

7: Darwin noted that the many different finch species on the Galapagos Islands had beak adaptations to suit local food sources. He hypothesised that the ancestor population of finches were blown over from mainland South America during a storm and settled on the islands.

1. Once on the islands, what was the barrier that isolated the populations of finches and prevented interbreeding?

(2 marks)

*The expanses of water between islands (1) meant that finches did not travel between islands often or at all, isolating the populations on each island (1).*

1. How did the selection pressures differ between the islands?

(2 marks)

*The islands have different climates (1) and therefore different food sources (1).*

1. What effect did these different selection pressures have on the finches?

(4 marks)

*Finches with beak development that suited the food sources available (1) were able to survive better (1), and then pass on the advantageous alleles (1) for beak type to their offspring (1).*

8: Describe in detail the process involved in producing synthetic Growth Hormone using recombinant DNA technology.

(15 marks)

*The gene that codes for human growth hormone is isolated from a healthy human cell. (1)*

*This happens using a restriction enzyme (1) that cuts at recognition sites (1) either side of the human growth hormone gene (1), separating the gene from the rest of the DNA strand (1). The restriction enzyme used produces staggered cuts with sticky ends (1) that match other strands that may be cut with the same restriction enzyme.*

*A plasmid is isolated from a bacterium (1), and cut using the same restriction enzyme (1) to produce matching staggered cuts and sticky ends (1). The plasmid DNA and the Human Growth Hormone gene are now placed together, matching the sticky ends (1).*

*The spliced DNA is then fused using DNA Ligase (1). The plasmid with the human growth hormone gene is a vector (1) that carries the gene into a new bacterium.*

*The plasmid containing the human growth hormone gene is then placed into a new bacterium (1). The bacterium will now reproduce, with each new bacterium containing a copy of the growth hormone gene. (1). The bacterial colony will then produce large amounts of growth hormone (1).   
  
The insulin produced by the bacteria is extracted (1) and refined (1), so that it can be used as a medication to treat Growth Hormone Deficiency. (1)*