Assessment Schedule – 2020

Biology: Demonstrate understanding of evolutionary processes leading to speciation (91605)

Evidence Statement

Question One

Evidence	Achievement	Merit	Excellence
Phenotypic changes typically arise due to mutation of DNA that can affect a metabolic pathway, or simply change the proteins produced. The wing form will be dictated by genes, and a permanent change to the genetic code will result in heritable differences in the wing patterns. Patterns leading to 'silent song' seen in the pictures may be selected for in populations. An adaptive advantage may include parasite evasion, and therefore more successful food gathering and mating passing their favourable alleles more often. Both islands' crickets have a similar phenotype, due to convergent evolution. This is a pattern of evolution seen when the same phenotypes are seen but they have not come from the same mutation. One did not give rise to the other. In this case they would have used DNA information, they would have sequenced the DNA of the gene / OR looked at the amino acids leading to the pattern changes. By looking at the DNA / RNA or proteins, they would be able to determine that the mutations are not the same, e.g. different mutation or similar, but at different loci, and this shows convergent evolution. It would be rapid, as those with the new trait would quickly become common as the wild type would have been parasitised and died. There could be different percentages, as one may be more recent OR it may have fewer parasitic flies in areas, so the selection pressure would not be as great.	• Mutation / change to metabolic pathway provides a new allele. • Selection pressure identified as the fly (which lays eggs in the cricket). • Different percentages described as being due to time . • Different percentages due to strength of the selection pressure (i.e. how many flies) • Convergent evolution defined as similar features arising in non-related species. • How DNA / RNA / protein can be used. • Describes scientists would see the environment (selection pressures) are similar / the DNA changes is not the same. • DNA used as a clock could show the timing of the mutation. • The wings are analogous structures which is what we see in convergent evolution. (mtDNA not valid here as female transmission.)	• Selection pressures for flatwing explained. • Selection pressures for similar phenotypes in silent crickets. • Explains reason for different proportions of the crickets on different islands. • Explains how convergent evolution comes about / is seen through independent mutations for the same trait. • Explains how molecular biology can lead to convergent evolution assumption.	• Knowledge of how DNA codes for the phenotypes seen, and mutation brings about new genes / alleles with any change to a gene pool over time infers an adaptive advantage to result in better survival for a given phenotype. Cricket phenotypic similarities is an example of convergent evolution, whereby similar selection pressures of the parasitic fly in similar environments of the islands have selected for similar phenotypes of the silent wing rubbing. • Knowledge of how DNA codes for the phenotypes seen, and how DNA / RNA / proteins are used by researches as evidence for convergent evolution, and mutation brings about new genes / alleles, with any change to a gene pool over time inferring an adaptive advantage to result in better survival for a given phenotype. Cricket phenotypic similarities are an example of convergent evolution, whereby similar selection pressures in similar environments have selected for similar phenotypes very quickly, due to strong selection pressure and death of other crickets.

Not Achieved			Achievement		Merit		Excellence	
NØ = no response or no relevant evidence.	1a	2a	3a	4a	2m	3m	1st E bullet point	Both E bullet points

Question Two

Evidence	Achievement	Merit	Excellence
Formation of a new species, i.e. speciation, if due to geographic isolation, is called allopatric whereas speciation that occurs in the same place is called sympatric and arises due to niche differentiation. Body lice for each bird are speciating sympatrically due to being on the same bird but having different niche and selection pressures. (OR allopatrically explained), but lice isolated on different host birds are speciating allopatrically. Preening behaviour of the host penguin is not affecting the survival rate of lice on the head, where the penguin cannot reach with its beak. Thus the round body-shape of head lice has been selected for, whereas the long thin shape of body lice has evolved due to pressing behaviour of the penguins. Adaptive radiation is the rapid formation of many new species from a common ancestor due to availability of new and different niches. In this case, adaptive radiation of penguin lice has led to the formation of 14 species, as different host bird populations are generally isolated from other birds, and louse demes (groups) form that eventually become reproductively isolated from other lice. The gene pool of fairy penguins is integrated with the NZ kororā when fairy penguins migrate and interbreed with the NZ birds. A gene pool is all the available alleles in a population – gene flow occurs due to reproduction and the heritable features of a gene pool integrating with all other members of a deme or clade. Reproductive isolating mechanisms are required for a new species to form. Pre-zygotic RIMs may be temporal, behavioural, ecological, geographical, or structural. They may be due to mutation resulting in different timing of mating, different courtship displays, different feeding patterns, preference for a different location or a change to the bird phenotype, e.g. reproductive structures or even feather colouration. Post-zygotic isolating mechanisms may also occur. Anything that disrupts the ability of two penguins to mate, fertilise eggs and bring them through to survive to adulthood and then reproduce will mean a reproductive isolation mechanism is involved – speciation may then follow as genetic differences accumulate.	The candidate has defined: • Speciation is formation of a new species. • Allopatric speciation – species evolving due to a geographic barrier. • Sympatric speciation – species evolve in the same place with no geographic barrier. • Adaptive radiation is the rapid formation of new species from a common ancestor. • The speciation between the body and the head lice is sympatric separation as same area. • The speciation between the body and the head lice is geographic barrier (if they mention the vast distance). • Describes the term reproductive isolating mechanism as that which stops successful reproduction. • Describes a pre- or post-zygotic isolating mechanism.	• Sympatric speciation has occurred in penguin head lice vs body lice on the same bird due to different selection pressures (or other). • Allopatry in lice occurs on different birds – the lice speciate due to isolation. • Head and body lice have different selection pressures; therefore speciate to form different phenotypes. • Adaptive radiation due to available niche with speciation of multiple chewing lice spread across one species of penguin has occurred (when penguin groups are separated and gene flow between lice groups stops). • Explains ONE reproductive isolating mechanism. • Explains a second reproductive isolating mechanism.	• Adaptive radiation in lice is discussed in terms of both types of speciation being quick, resulting in many species due to available niche, RIMS are discussed in terms of the penguins. • Reproductive isolating mechanisms are discussed in terms of penguins and the New Zealand context as a reason for speciation to occur. Two or more of: - temporal - behavioural - ecological - geographical - structural. Adaptive radiation in lice is discussed in terms of new species occurring as penguin groups become isolated from each other, e.g. the Australian and New Zealand groups and copulatory behaviour that allows opportunities for gene flow between (demes or clades) of lice has stopped.

Not Achieved			Achievement		Merit		Excellence	
NØ = no evidence or no relevant evidence.	1a	2a	3a	4a	2m	3m	1st E bullet point	Both E bullet points

Question Three

Evidence	Achievement	Merit	Excellence
The anteater-ant relationship is an example of coevolution. Each species is a selection pressure on the gene pool of the other species. Anteaters are specific in their diet, and teeth are not required. Mutations in anteater evolution that meant a loss of teeth have been selected for over time as a selective advantage in consuming large numbers of ants and termites. Teeth are energy-consuming to produce, edentate animals conserve energy by not coding for their development. Thus, these animals, over millions of years have had better reproductive success. The ancestral anteater has undergone divergent evolution / adaptive radiation. An ancestral species has diverged to form new species that can occupy different niches; in this case, arboreal, nocturnal, dwarf and giant, and in different habitats across South America, as seen in the maps. Natural selection is the process by which there is differential success in members of a population – leads to divergent evolution in that when phenotypes are successful and individuals breed, their allele combinations are passed down more often, and so change the allele frequencies between groups. Over time, new mutations may not be acquired through gene flow, RIMS can develop, and we will have groups now reproductively isolated from one another.	• Ant phenotypes act as selection pressures for the anteater's thick skin and specialised mouth. • Anteater predation is a selection pressure for the ants and venom production in soldier ants. • Coevolution is defined as two species that act as selection pressures on the evolution of each other. • Natural selection described as some members having more success due to phenotypes. • Disadvantage is that if the ants go extinct the anteater might too / the soldier ants may not arrive in time. • Advantage in that it results in the species having traits that can be helpful in surviving / they are the only species in that niche / less competition.	• Advantage of coevolution is given as a solution to resourcing for both species. • Disadvantages are given to include change or loss of one species may cause loss of the other species. • Coevolution results in a lack of variation, which makes a species vulnerable to habitat change. • Natural selection explained as some members having more success due to phenotypes, which in turn are due to genotypes, which in turn are due to mutation. • Divergent evolution explained.	• Discussion involves coevolution and how divergent evolution / adaptive radiation has occurred through natural selection (in anteaters as the evolutionary ancestral group has speciated to fill different niche, removing competition, to become arboreal, nocturnal, or giant). • Discussion involves the costs and benefits (to ants and anteaters) of coevolution, and the links between natural selection and divergent evolution.

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Not Achieved			Achievement		Merit		Excellence	
NØ = no response or no relevant evidence.	1a	2a	3a	4a	2m	3m	1st bullet point	Both bullet points

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24