Assessment Schedule – 2021

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

Evidence Statement

Question One

Evidence	Achievement	Merit	Excellence
Members of the one species breed and produce fertile offspring. Speciation is the process by which new species are formed from ancestral ones / existing species. Genetic drift is the random fluctuations in the frequencies of alleles from generation to generation due to chance events. This is much more evident in small populations such as whio. Gene flow is when individuals move between populations, and this allows new mutations / new combinations of alleles to move into each population; thus the species **does not** diverge. Mutations are the source of all new alleles / variation and can bring about new traits. Natural selection selects for favourable phenotypes – thus selecting for mutations / genotypes. Some individuals have more reproductive success than others and leave more viable offspring over their lifetime. The North and South Island whio populations are both small, so if they diverge further, this will further decrease their gene pools. This could mean that both populations, or one, are likely to become extinct. For speciation to occur in the future, there needs to be something to stop gene flow. The whio's limited flight may mean that they will be in geographically separated populations, which may result in allopatric speciation. They will show divergent evolution due to lack of gene flow, and over time, new phenotypes may develop through mutation, that are also reproductively isolated (RIMS).	• Species defined. • Speciation defined. • Describes genetic drift. • Describes a process leading to more obvious genetic drift (e.g. founder effect / bottleneck). • Describes gene flow. • Describes mutations. • Describes natural selection as those with favourable traits survive and reproduce more. • Describes a possible outcome for North and South Island species e.g further divergence or extinction. • Allopatric speciation would occur with the mountains / Cook Strait / North and South as a barrier.	• Explains how genetic drift influences small populations of whio. • Explains gene flow and consequence to speciation. • Explains natural selection in whio. • Explains a possible future. • Explains how limited flight could lead to allopatric speciation. • Explains divergent evolution. • Explains whio may show directional selection. • Explains RIMS may develop between *spp*.	• Discussion of factors that lead to the **evolution** in whio through mutation selected for, natural selection (may mention directional or mate selection), and genetic drift (due to numbers), and how this influences the number in the populations and therefore the success of the population, and how, over time, accumulation of changes can lead to reproductive isolation and speciation. • Discussion of factors which would influence the **future speciation** of whio: With the lack of gene flow (reason given), the *spp* may diverge, and after allopatric speciation, the future would be **less** successful, as each species' numbers would be small.

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

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Question Two

Evidence	Achievement	Merit	Excellence
Convergent evolution is a pattern of evolution. We see, when looking back over many speciation events, a pattern in that different, non- (recently) related groups develop similar traits / features / adaptations. This is not due to a common ancestor but is due to **independent** random / spontaneous mutations being selected for in different groups, as there is similarity in their selection pressures. For example, the selection pressure of being able to survive in a harsh environment, e.g. wind with little rain may select for long roots and short stature and these favourable alleles are selected for and are passed onto successive generations. Prezygotic isolating mechanisms are those that prevent successful fusing of gametes, e.g. chemical isolation, where the ova and pollen cannot fuse due to biochemical differences. Also, mechanical isolation, when the pollen may not sit on the stigma correctly, or ecological isolation, temporal isolation (must be relevant to plants). Many areas of the world have harsh environments, and it is due to random mutations and natural selection that we see cushion plants develop in such areas.	• Convergent evolution defined. • Independent mutations described, i.e no common ancestor. • Describes a pre-zygotic RIM. • Describes a 2nd pre-zygotic RIM. • Identifies that many areas have harsh environments, so random mutations / new phenotypes are selected for.	• Explains how cushion plants can occur through convergent evolution. • Explains how random / spontaneous mutations can be selected for in many different areas, giving similar traits. • Explains a pre-zygotic RIM that prevents hybridisation. • Explains a 2nd pre-zygotic RIM that prevents hybridisation. • Explains how selection pressures can result in different groups having cushion plants. • Explains that mutations occurred **independently** in each group of plants without a common ancestor.	• Discusses convergent evolution being related to mutation and natural selection. Clear understanding of how they are different species, and how they end up with very similar features, but don't hybridise (due to RIMS). • Discusses how areas of the world with harsh environments (must link in contexts provided) could have non-related species that look the same through random mutations in different areas of the genome, or the same, being selected for.

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

Question Three

Evidence	Achievement	Merit	Excellence
Gradualism and punctuated equilibrium are described – both rates of evolution / patterns of evolution. For us to see gradualism, we see a gradual change (in morphology / many intermediate forms) due to the selection pressures remaining constant, as even though mutations still randomly occur, no major change in form is selected for. In punctuated equilibrium, we see long periods of the same form being selected for (stasis), and interrupting this, we see suddenly (in the fossil record new forms / species) that would have resulted from diverse selection pressures selecting rapidly for a change in form. Thus, mutations that offered a different trait are selected for. Data shown in Fig 1 show the large number of olive shell species around New Zealand. Each are in different environments where the abiotic and biotic factors would be different. Prior to 15 mya (Fig 2), there was only one species. In punctuated equilibrium we see a long period of stasis where evolution is occurring, still with mutations. However no great variant is selected for, due to similar environmental conditions. However, when the olive shells were in New Zealand, we saw the rise of many new variants / different morphologies / different species, and over the past 5 million years, there have been another 6 species. The pattern shown here is divergent evolution.	• Gradualism defined. • Punctuated equilibrium defined. • Describes the graph (Fig 2) using a specific piece of data. • Describes a 2nd trend / data point in Fig 2. • Identifies the pattern as divergent evolution (accept adaptive radiation).	• Explains punctuated equilibrium in relation to mutation and selection pressure. • Explains how the data shows PE with rapid new forms. • Explains how speciation led to different forms of shells (size, pattern etc) as a result of mutations. • Explains how divergent evolution occurs due to species splitting into two. • Uses data to explain divergent evolution from ancestral species.	• Discusses punctuated equilibrium in the shells through sound knowledge of the underpinning definitions, as well as explanations of rates of evolution, using data provided. Knowledge of many species due to mutation of different morphologies being selected for – therefore many environments with different selection pressures. • Discusses divergence of olive shells using data from Fig 2 to clearly show how at times novel forms (due to mutation) are selected for, and these then diverge to form new species over the past 15 MY.

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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 – 18	19 – 24