Assessment Schedule – 2020

Scholarship Biology (93101)

Evidence Statement

QUESTION ONE: HOCHSTETTER'S FROG: Evidence Statement

Discusses how the biology of the Hochstetter's frog affects the survival of the individual (**I**).

	Evidence		Justification
IN	Hochstetter's frogs are nocturnal and so are active at night when their diurnal predators such as green and golden bell frogs aren't active.		
IS	Sheltering in crevices and / or under stones or logs during the day means that they avoid being seen by predators.		
IA	If they are threatened, they remain motionless to avoid being noticed by predators because they are camouflaged.		
IT	If they are threatened, they swim away quickly, looking for threats by moving their heads side to side to avoid predators.		
IC	Do not croak / make calls and so avoid exposing their location to predators.		
		IIJ	Any of points IN, IS, IA, IT, IC linked to an increase in survival of the individual.
IP	Negative phototaxis of larvae.	**IPJ1** **IPJ2**	When in the larvae form, they swim away from the light to avoid being seen, therefore avoiding predation from predators. This is an innate response, as the frog larvae show the response on the day of hatching / without having been taught this response. This means the response must be genetically programmed / not a learned one.
IF	Larvae do not feed during development.	**IFJ**	Reduces intraspecific competition for the young, ensuring greater chances of individual survival as they do not compete for food resources.
IR	No parental care is required / large number of eggs laid	**IRJ1** **IRJ2** **IRJ3**	The Hochstetter's frog is r-selected species. Low energy requirements of the parents' investment in caring for the young meaning energy can be used for other things. High energy / resource requirements in production of a large number of gametes.

Discusses how the biology of the Hochstetter's frog impact the future evolution of the populations in the different locations. (**P**).

	Evidence		**Justification**
PL	The life span of the Hochstetter's frog is 30 years, meaning it can produce a large number of offspring over its life. This results in a higher chance of survival of the population.		
PR	Froglets reach maturity in three to four years, which is negative for the species' survival, as frogs may be killed in the time it takes to reach breeding age		
PA	There may be different selection pressures in each population.	**PAJ1**	Different areas have different allele frequencies, as shown by the five populations all having different MHC allele frequencies.
		PAJ2	Populations have different combinations and frequencies of the MHC alleles, which means that they have proteins on the surface of their cells that help them to be immune to the diseases associated in the different areas. This means they are better adapted to the site that they are found, and are better able to survive as a population.
PO	The Otawa population has less genetic diversity than the others.	**POJ1**	Only has MHC alleles 3 and 4 in that population / MHC alleles 1 and 2 have been lost.
		POJ2	This means lower genetic variation in the Otawa population, which means that this population is less adaptable to changes in the environment.
		POJ3	Alleles may have become lost due to genetic drift.
PF	The populations seem to be isolated from each other / lack of gene flow between populations.	**PFJ**	This means that the populations could diverge into different species due to allopatric speciation.

Judgement statement (the two areas are I and P)

8	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* to discuss the Hochstetter's frog survival of the individual and the survival of the population. 8 Js or 7 Js and 2 descriptions. Must have 2 Js from at least 2 areas. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
7	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* to discuss the Hochstetter's frog survival of the individual and the survival of the population. 7 Js or 6 Js and 2 descriptions or 5 Js and 4 descriptions. Must have 1 J from at least 2 areas. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	Biological evidence is selected and organised into a discussion of the Hochstetter's frog survival of the individual and the survival of the population. 6 Js or 5 Js and 2 descriptions or 4 Js and 4 descriptions. Must have 1 J from at least 2 areas. Answer displays: • analysis and critical thinking • integration, synthesis, and application of highly developed knowledge, skills and understanding • logical development, precision, and clarity of ideas.
5	Biological evidence is selected and organised into a discussion of the Hochstetter's frog survival of the individual and the survival of the population. 5 Js or 4 Js and 2 descriptions or 3 Js and 4 descriptions. Answer displays aspects of: • analysis and critical thinking • integration, synthesis, and application of highly developed knowledge, skills and understanding • logical development, precision, and clarity of ideas.
4	4 Js or 3 Js and 2 descriptions or 2 Js and 4 descriptions.
3	3 Js or 2 Js and 2 descriptions or 1 J and 4 descriptions.
2	2 Js or 1 J and 2 descriptions or 4 descriptions.
1	1 J or 2 descriptions.
0	Lack of relevant evidence.

QUESTION TWO: YELLOW MONKEYFLOWERS: Evidence Statement

Discusses the ecological and evolutionary processes that have resulted in the differences between the thermal and non-thermal populations of *E. guttata* in YNP (**T**).

	Evidence		**Justification**
TS	Speciation may be occurring thermal and non-thermal populations	**TSJ1** **TSJ2**	In future the thermal and non-thermal populations may diverge into two species. Likely to be sympatric speciation
TI	RIMs are starting to isolate the thermal and non-thermal populations.	**TIJ1** **TIJ2**	Temporal isolation due to timing of flowering in different seasons with non-thermal in mid-summer compared with thermal in late winter. Ecological isolation due to different habitats. Thermal populations able to survive in areas with hotter soils that dry in summer, whereas non-thermal can survive in areas that freeze over in winter.
TF	Thermal plants are self-pollinated vs non-thermal are cross-pollinated	**TFJ1** **TFJ2**	Self-pollination in thermal likely due to lack of pollinators around in winter when it flowers / cross-pollination in non-thermal due to presence of pollinators in summer Stigma and anthers – close together in thermal plants increases chance of self-pollination / far apart reduces chance of self-pollination in non-thermal.
TN	Selection occuring for plants able to survive in thermal habitat that doesn't freeze in winter but dries in summer.	**TNJ1** **TNJ2**	Thermal habitat was a vacant niche. Flowering in winter allowed thermal plants to reproduce before soils dry out in summer.
TG	Short-growth form of thermal plants (flowers close to ground / short internodes) keeps them closer to warm soil.	**TGJ1** **TGJ2**	Reduces the risk of the plant / flowers freezing in winter. No need for tall flowers as don't need to attract pollinators / are self-pollinated.
TR	Thermal are annuals / produce more flowers / have less biomass than the non-thermal plants.	**TRJ**	Thermal plants put more of their resources / investment into reproduction when compared to non-thermal as they need to reproduce before the soils dry in summer. OR Non-thermals put more resources into growth as they are perennials that can survive over winter for a number of years.
TL	Thermal plants are short-day plants compared to non-thermal which are long-day plants.		

Discusses the ecological and evolutionary processes that have resulted in the differences between *E. guttata* and *E. nastua* (**G**).

	Evidence		**Justification**
GR	RIMs separate *E. guttata* and *E. nastua. / E. guttata* and *E. nastua* are reproductively isolated / unable to breed with each other.	**GRJ1**	Temporal isolation due to timing of flowering in different seasons, *E. guttata* in summer cf *E. nastua* in early spring.
		GRJ2	Ecological isolation due to different habitats. *E. guttata* needs moist soils but *E. nastua* dries out over summer.
		GRJ3	Structural isolation due to flowers of *E. nastua* not able to be pollinated by bees as they have closed flowers.
GP	*E. guttata* is a long-day plant vs *E. nastua*, which is a short-day plant.	**GPJ**	*E. guttata* has a CDL of greater than 13h / flowers when days more than 13h whereas *E. nastua* has a CDL of less than 9h / flowers when days less than 13h.
GB	*E. guttata* has a broad niche / is a generalist.	**GBJ**	It can occupy a wide range of habitats such as a wide altitude range, forests, grasslands, mine tailings etc.
GC	Selection for plants able to survive in habitat that dried out over summer.	**GCJ1**	Likely to be intense competition as *E. guttata* has a broad niche and can be an invasive species.
		GCJ2	Intraspecific competition for space led to a population of *E. guttata* adapting to areas that dry out in summer to reduce competition.
		GCJ3	Flowering early allowed plants to reproduce before dry soils in summer.
GE	*E. guttata* and *E. nastua* have diverged / show divergent evolution.		
GD	*E. nastua* likely started as a small population.	**GDJ1**	*E. nastua* has only ¼ diversity of *E. guttata*, so alleles may have been lost due to genetic drift.
		GDJ2	Accumulation of harmful alleles possibly due to inbreeding in a small population / as it is self-pollinating.
GM	Mutations changed genes responsible for flower timing / flower shape / pollination system in *E. nastua.*	**GMJ1**	Mutations may have affected genes involved in the phytochrome system / critical-day-length genes, as this can control flowering responses.
		GMJ2	Mutations involving flower shape / structure promoted self pollination and limited gene flow.
GS	Sympatric speciation has occurred between *E. guttata* and *E. nastua.*	**GSJ1**	The two species have an overlapping range, but are unable to interbreed due to the presence of RIMs.
		GSJ2	Polyploidy leading to instant speciation may have occurred.

Judgement statement (the two areas are S and G)

8	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* to discuss the evolutionary and ecological processes involved in the evolution of yellow monkeyflowers. 8 Js or 7 Js and 2 descriptions. Must have 2 Js from at least 2 areas. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
7	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* to discuss the evolutionary and ecological processes involved in the evolution of yellow monkeyflowers 7 Js or 6 Js and 2 descriptions or 5 Js and 4 descriptions. Must have 1 J from at least 2 areas. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	Biological evidence is selected and organised into a discussion of the evolutionary and ecological processes involved in the evolution of yellow monkeyflowers 6 Js or 5 Js and 2 descriptions or 4 Js and 4 descriptions. Must have 1 J from at least 2 areas. Answer displays: • analysis and critical thinking • integration, synthesis, and application of highly developed knowledge, skills, and understanding • logical development, precision, and clarity of ideas.
5	Biological evidence is selected and organised into a discussion of the evolutionary and ecological processes involved in the evolution of yellow monkeyflowers 5 Js or 4 Js and 2 descriptions or 3 Js and 4 descriptions. Answer displays aspects of: • analysis and critical thinking • integration, synthesis, and application of highly developed knowledge, skills ,and understanding • logical development, precision, and clarity of ideas.
4	4 Js or 3 Js and 2 descriptions or 2 Js and 4 descriptions.
3	3 Js or 2 Js and 2 descriptions or 1 J and 4 descriptions.
2	2 Js or 1 J and 2 descriptions or 4 descriptions.
1	1 J or 2 descriptions.
0	Lack of relevant evidence.

QUESTION THREE: DENISOVANS, NEANDERTHALS and MODERN HUMANS: Evidence Statement

Compare and contrast how the biological features of Denisovans, Neanderthal and modern humans may have supported their survival.

(B) Biological features

	Evidence		**Justification**
BB	Neanderthals and Denisovans have a higher bone density (are more robust) than modern humans.	**BBJ1** **BBJ2**	A higher bone density provides better support for greater muscle mass. Higher bone density reduces risk of physical injury, which increased their survival chances.
BS	Neanderthals are shorter and stockier than modern humans.	**BSJ**	Neanderthals had smaller bodies that were adapted to the colder conditions / there is less body surface area for heat to be lost from.
BF	Denisovans / Neanderthals have a sloping / smaller forehead / flatter top of cranium than modern humans.	**BFJ1** **BFJ2**	This means that they have a slightly smaller frontal lobe / forebrain. This part of the brain region controls decision making, social behaviour, as well as creativity and abstract thought. This leads to greater survival for the modern humans.
BM	Denisovans have thicker enamel on teeth / a wider and taller front jaw / protruding jaw than modern humans.	**BMJ1** **BMJ2**	This shows that modern humans eat softer, more processed foods Smaller jaws / less enamel etc saves energy / resources the body needs to produce them, which increases survival chances.
BH	Denisovans have larger hand bones / wider fingers than modern humans.	**BHJ**	This shows that modern humans have more dexterity / precision in hands, which allows more complex Upper Paleolithic tools, which increases our survival chances.

Discuss how the evidence presented here has contributed to our understanding of the evolution of Denisovans, Neanderthal and modern humans. (**E**) Evolution.

	Evidence		**Justification**
EF	Fossil evidence.	**EFJ1** **EFJ2** **EFJ3**	Material found with the fossil / location of the fossil helps with understanding the environment the hominin lived in / their way of life The age of the fossils in each location shows their dispersal The age of the fossils shows all three species existed at same time
ED	DNA evidence from the fossils.	**EDJ1** **EDJ2**	Some fossils' DNA has been extracted which has allowed us to compare genes between species and DNA sequences have been determined. By comparing DNA of different fossils of the same species found in different areas a relationship based on similarities of DNA sequences can be determined.
EP	Protein evidence.	**EPJ**	By using the proteins, the sequence of amino acids could be determined and used to determine possible DNA sequences to compare with other hominins.

EC	Neanderthals and Denisovans (and modern humans) evolved from a common ancestor.	**ECJ**	Due to isolation and different selection pressures, they would have evolved differently.
EG	Modern human populations have other hominin DNA / genes as part of their genetic material.	**EGJ1**	As these modern humans passed through Asia / Eurasia they must have reproduced with the Denisovans, gaining the EPAS1 / TBX15 / WARS2 genes.
		EGJ2	Interbreeding with other hominins introduced genes adapted to that particular region, which increased the survival chances of modern humans.
		EGJ3	The EPAS1 gene, allowing individuals that were better selected to survive in higher altitudes (like the Tibetans).
		EGJ4	TBX15 and WARS2 genes from Denisovans would have helped modern humans survive in colder regions.
		EGJ5	Modern humans that migrated to Europe / stayed in Africa do not have the EPAS1 gene, as these hominins did not interbreed with Denisovans.
		EGJ6	The changes to the FOXP2 / HLA gene occurred before the divergence between all 3 species, as each one has the FOXP2 / HLA gene.
		EGJ7	Each hominin had the same FOXP2 gene, and therefore had language.
		EGJ8	The fact that all non-African modern humans have Neanderthal DNA supports the Replacement / Out Of Africa / hypothesis.
ET	Tool evidence.	**ETJ1**	Presence of bone needles shows Denisovans could have made clothing.
		ETJ2	Bone needle is evidence Denisovans produced advanced tools.
		ETJ3	Tool technology / manufacturing techniques may have been shared between hominin species.
		ETJ4	Mousterian / UP tools provided access to better quality / wider range / more nutritious food which increased the survival / allowed brain expansion of the hominins.

Judgement statement (the two areas are S and G)

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Cut Scores

Scholarship	Outstanding Scholarship
13 – 18	19 – 24