No. 102/2

Pacific Community
Communauté du Pacifique

EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

EQAP

B

Scoring Rubric 2019

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South Pacific Form Seven Certificate

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Item #	Skill score	Evidence	Skill Level			
			1	2	3	4
STRAND 1 ANIMAL BEHAVIOUR						
1.1a	1	<u>Ecological niche</u> • Functional role of an organism in its habitat • Position of an organism in its habitat; how it meets its needs for food and shelter, how it lives/survives, and how it reproduces.	One correct idea stated Not: where it leaves and not: characteristics			
1.1b	2	Ecological niche of the coconut crab • Has the ability to use massive pincers to crack open the coconuts. • They drop coconuts from trees and strike them with their pincers splitting the seed open.	One correct idea stated	Two or more correct ideas stated Any behavioural or structural aspect and reason for that aspect		
1.2	2	Features of Learned behaviour • Can be modified to suit changing conditions • More adaptive/less rigid than innate behaviours • Learn through experience • Ability to learn through intelligence	One correct idea stated	Two or more correct ideas stated Egs include human learning of language etc.		
1.3a	1	Species X is **K selected**	Correct response			
1.3b	3	K- species' reproductive strategy is • to grow slowly, • live close to the carrying capacity of their habitat • produce a few progeny each with a high probability of survival Thus survival to adulthood is ensured because the organisms are • Strong and well protected • Parental care is greater • Mature slowly • Energy use is efficient • Have fewer offspring and females have better recovery time – reduce competition • Reproduce at a later age – stronger for reproduction and better survival of mother	One correct idea stated regarding either reproductive behaviour OR how survival is influenced	Two or more correct ideas stated regarding either reproductive behaviour OR how survival is influenced	States two or more reproductive behaviours of K species and explains how these ensure survival of the organism	

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1.4	2	Features of predator-prey relationship • Evolve together • Prey population fluctuates ahead of the predator population • Change in adaptations for their purpose but relationship remains the same • Prey population number always greater than predator population number	One correct idea stated	Two or more correct ideas stated		
1.5	4	i. Biological clock (BC): an innate/inner mechanism that controls the physiological activities of an organism which change on a daily, seasonal, yearly, or other regular cycle ii. An environmental destruction – damage from cyclone/hurricane, tsunami, flooding, toxin/oil spills, pollution, use of fossil fuels/production of GHGs, forest fires, deforestation, mining, overfishing/ overharvesting, erosion, invasive species/oxygen deficiencies iii. Implications on biological clock: - Disrupts rhythm: biological functions don't occur within normal time schedules. - Rhythms are suppressed - Affects reproduction, growth, longevity and other behaviours iv. Effect on survival of organisms – migrations don't happen as scheduled – organisms may die from excessive temperatures - weight gain, impulsivity, slower thinking, - physiological and behavioral changes in mice, similar to those observed in people who experience shift work or jet lag. Example is *Daphnia pulex*	One correct idea is stated	Two or more correct ideas	BC and environment destruction defined with examples Implications of changes on biological clock explained	BC and environment destruction defined with examples. Implications of changes on biological clock explained. Example used and reflection of outcome to organism/ population/species provided

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STRAND 2 GENE EXPRESSION						
2.1a	1	One strand of the parent double helix is conserved in each new DNA daughter molecule.	Correct definition provided			
2.1b	2	Replication takes place in the 5' to 3' direction. As a result, one strand of parent DNA will be continuously replicated and this is the leading strand. The other strand of the parent DNA will be replicated in short (broken) fragments – this is the lagging strand. The fragments are called Okazaki fragments, joined by DNA ligase	One correct idea stated	Two or more correct ideas stated		
2.1c	3	Causes of problems in DNA replication • deletions and insertion of incorrect bases by DNA polymerase (mismatch repair) substitution/duplication • removal of RNA primers – information lost at the ends of linear DNA • tautomeric shifts • Mispairings of base pairs (wobble) due to orientation of base Why these are problems? • Result in (inheritable) mutations/changes in DNA • Development of diseases such as cancer	One correct idea/cause stated No ideas related to protein synthesis	Two or more correct ideas on the causes are stated	Clear explanations of how the causes are a problem	
2.2a	1	Protein synthesis is the process of creating/making protein molecules Involves transcription and translation	One correct idea stated			
2.2b	1	Letter **X** represents <u>mRNA</u>	Correct response			
2.2c	1	Function of mRNA • carries the genetic information copied from DNA in the form of a series of three-base code "words," each of which specifies a particular amino acid. • Copies DNA and transfers to the ribosome	One correct idea stated			
2.3	2	Each three base sequence of the mRNA, called a codon; Identifying the first, second and third base positions on the code will determine the subsequent amino acid that is being	One correct idea stated	Two or more correct ideas stated with use of example		

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<tr><td></td><td></td><td>coded for by the codon
Eg the codon UGG codes for Tryptophan</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.4a</td><td>1</td><td>Mutation is a change or alteration in DNA sequence/base sequence/ number of chromosomes</td><td>Correct definition</td><td></td><td></td><td></td></tr>
<tr><td>2.4b</td><td>3</td><td><table><tr><th>Chromosome mutation</th><th>Gene mutation</th></tr><tr><td>alteration occurs in a segment of a chromosome in chromosomal mutations.</td><td>alteration occurs in the nucleotide sequence of a gene</td></tr><tr><td>Several genes are affected</td><td>A single gene is affected</td></tr><tr><td>Chromosomal mutations can sometimes be lethal</td><td>The influence of gene mutation is comparatively low</td></tr><tr><td>Klinefelter syndrome, Turner syndrome, and Down syndrome are caused by chromosomal mutations</td><td>Sickle cell anemia, hemophilia, cystic fibrosis, Huntington syndrome, Tay-Sachs disease, and cancers are caused by gene mutations</td></tr></table></td><td>One correct idea stated on either mutation</td><td>Two or more correct ideas stated on either mutation</td><td>Complete and correct comparisons of the two types of mutations provided Examples are provided</td><td></td></tr>
<tr><td>2.5a</td><td>1</td><td>Feature of sex-linked conditions
• Genes found on the sex chromosomes
• More common in males than in females;
• Generally, genes are recessive
• Rare condition
• Females are carriers</td><td>One correct idea stated</td><td></td><td></td><td></td></tr>
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<tr><th></th><th></th><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>2.5b</td><td>3</td><td>Compare linkage and sex-linked<table><tr><th>Linkage</th><th>Sex-linked</th></tr><tr><td>Genes found on the same chromosome</td><td>Genes found on the sex chromosomes</td></tr><tr><td>Patterns of inheritance not different in males and females</td><td>Patterns of inheritance different in males and females</td></tr><tr><td>Genes that are genetically linked are inherited separately less than 50% of the time. The closer together the linked genes are, the less likely it is that a recombination event will happen between them</td><td></td></tr></table></td><td>One correct idea stated</td><td>Two or more correct ideas stated on either linkage or sex-linked</td><td>Complete and correct comparison of linkage or sex-linked provided</td><td></td></tr>
<tr><td>2.6a</td><td>1</td><td>Epistasis:
the interaction of genes that are not alleles, in particular the suppression of the effect of one such gene by another</td><td>One correct idea stated/correct definition</td><td></td><td></td><td></td></tr>
<tr><td>2.6b</td><td>1</td><td>Feature of Pleiotropy
• One gene has an influence on the phenotype of multiple genes
• arise from several distinct but potentially overlapping mechanisms</td><td>One correct idea stated</td><td></td><td></td><td></td></tr>
<tr><td>2.7</td><td>4</td><td>[Q: Discuss effects of environment on the expression of genotype]
i. Genotype is the set of genes in our DNA which is responsible for a particular trait. The phenotype is the physical expression, or characteristics, of that trait.
ii. Factors that affect phenotype include temperature, resource availability, exposure to sunlight/wind/rain/etc, /drugs/humidity/stress</td><td>One correct idea stated</td><td>Two or more correct ideas stated on environmental factors that may affect genotype</td><td>Two or more correct ideas stated on environmental factors that may affect genotype</td><td>Genotype and phenotype defined with examples Environmental factors that may affect genotype named and</td></tr>
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		iii. Nutrition is an important element. Consider two animals containing the same genotype. One of the animals is fed plentiful, while the other is not sufficiently fed. Naturally the first animal will have a better yield. Other environmental factors which can be mentioned: temperature, draft, humidity, stress or poor management, which in itself contains several environmental factors. For example person A has tall phenotype in his gene but because if he doesn't eat a good diet like lack of protein or calcium or doesn't do much exercise so it affected their phenotype. iv. Temperature: at 21°C tuatara eggs have equal chance of hatching male or female. At <21°C (slightly cooler) chances of being female are greater; and at >23°C (slightly hotter), chances of being male are greater				explanations of their effects. Example used and reflection on result on the population/species
STRAND 3 BIOTECHNOLOGY APPLICATIONS						
3.1a	1	Gene gun is a device for delivering exogenous DNA (transgenes) to cells/oranisms/DNA.	One correct idea stated			
3.1b	2	It is called a gene gun because it fires small DNA-coated particles (typically gold or tungsten particles because they are dense) into target cells. Gene for resistance to pests is coated with Au or W and fired into the target cell - Maize	One correct idea stated	Two or more correct ideas on how the process is implemented		
3.2a	1	Define Gel Electrophoresis • is a laboratory method used to separate mixtures of DNA, RNA, or proteins according to molecular size/weight • the molecules to be separated are pushed by an electrical field through a **gel** that contains small pores • use of electricity	One correct idea stated			
3.2b	1	Feature of GE • separates molecules according to size and charge • Used to analyze results of PCR and genes associated with a particular illness	One correct idea stated			

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		• Used to develop DNA profiles for distinguishing different species and identification • In paternity testing using DNA fingerprinting • study of structure and function of proteins • In the analysis of antibiotic resistance • Use of gel wells and electricity/anode and cathode				
3.2c	2	[Q*: describe the formation of DNA profiles using the techniques of gel electrophoresis*] • Samples of fragmented DNA are placed in the wells of the gel • gel is placed in a buffering solution and an electrical current is passed across the gel • negatively charged DNA moves to the positive terminus (anode) • Smaller fragments are less impeded by the gel matrix and move faster through the gel • The fragments are thus separated according to size forming the profile	One correct idea stated	Two or more correct ideas stated		
3.2d	1	Feature of DNA profiling technique • Uses PCR to produce many copies of specific Short Tandem Repeats sequences • Can be applied to any human sample that contains cells with nuclei (urine, hair, semen, saliva) • Used for parentage testing • Establish immigration eligibility • Used in genealogy and medical research	One correct idea stated			
3.2e	2	[Q: *uniqueness of DNA*] • Each DNA strand contains a unique sequence or code of genetic information. • 'minisatellites' (short sequences of chemical building blocks) show variation in the numbers of repeat units (or stutters) unique to each person	One correct idea stated	Two or more correct ideas stated		

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		• what makes us unique is a measly 0.1% of our genome. This may seem insignificant. But what these declarations fail to point out is that the human genome is made up of three billion base pairs—which means 0.1% is still equal to three million base pairs.				
STRAND 4 PROCESSES AND PATTERNS OF EVOLUTION						
4.1a	1	Meiosis	One correct idea stated			
4.1b	3	How meiosis affects Genetic Variation (GV) 1. **Crossing Over**. During prophase of meiosis I, the double-chromatid homologous pairs of chromosomes cross over with each other and often exchange chromosome segments. This recombination creates genetic diversity as genes intermix, resulting in chromosomes with a different genetic complement. 2. **Reduction of haploid** and the distribution of each chromosome is random. This means that it is equally likely for a given chromosome to be distributed to either of the two daughter cells. By shuffling the genetic deck in this way, the gametes resulting from meiosis II have new combinations of maternal and paternal chromosomes, increasing genetic diversity. 3. **Random chromatid assortment** A third source of genetic diversity occurs during meiosis II, in which the sister chromatids separate and are randomly distributed to the daughter cells, the gametes. The outcome of which chromosome will go to which gamete is random, so that each gamete has a potentially unique combination of genetic material. 4. **Fertilisation** creates genetic diversity by allowing each parent to randomly contribute a unique set of genes to a zygote. Fertilization depends on meiosis creating haploid gametes. The fertilized cell restores the diploid number. Without meiosis, the	One correct idea stated	Two or more correct ideas	Two or more correct ideas with correct explanation on how GV is obtained	

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		number of chromosomes per cell would double in each generation of offspring, leading to unstable conditions that could threaten the viability of a species.				
4.2a	1	Founder Effect is the loss of genetic variation that occurs when a new population is established by a very small number of individuals from a larger population.	One correct idea stated			
4.2b	2	The Founder Effect is defined as "a type of genetic drift describing the loss of the allelic variation that accompanies founding of a new population from a very small number of individuals (a small sample of a much larger source population). [GD: variation in the relative frequency of different genotypes in a small population, owing to the chance disappearance of particular genes as individuals die or do not reproduce]	One correct idea stated	Two or more correct ideas stated		
4.3a	1	• Common in plants • Occurs within one generation • Quick and instant process with doubling/tripling of N • [Definition: Plants can speciate almost instantaneously by changing the ploidy (number of sets) of their chromosomes, accompanied by their ability to persist/disperse as "founders" via asexual reproduction.]	One correct idea stated			
4.3b	3	[Q: *Explain why GI leads to reproductive isolation and speciation*[Geographic isolation prevents cross breeding between the populations that have been separated by the isolation. Geographic isolation caused by rivers changing course, mountains rising, continents drifting, organisms migrating, and what was once a continuous population is divided into two or more smaller populations. Organisms in the different population are not easily accessible to each other to make reproduction possible As a result, populations do not interact, and over time, slight mutations differences and other changes within two populations make organisms different so that if place together, organisms from the two populations cannot interbreed. They have become two different species.	One correct idea stated	Two or more correct ideas stated	Included in the response is a reason for why organisms cannot interbreed due to GI	
4.4a	1	**Coevolution** • the influence of closely associated species on each other in	One correct idea stated			

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<tr><td></td><td></td><td>their evolution.
• occurs when two or more species reciprocally affect each other's evolution.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.4b</td><td>3</td><td>Comparing and contrasting<table><tr><th>Divergent</th><th>Convergent</th></tr><tr><td>Process by which an interbreeding species diverges into two or more descendent spp (same ancestor)</td><td>Process where distantly related species develop similar structures as adaptation to the environment (diff ancestor)</td></tr><tr><td>Live in different environments than their ancestor</td><td>Both spp live within the same environment</td></tr><tr><td>Divergence of two diff spp results in the two spp becoming less like the common ancestor</td><td>Unrelated organisms evolve similarities while adapting to a common environment</td></tr><tr><td>Occurs though developing analogous structures</td><td>Occurs through developing homologous structures</td></tr></table></td><td>One correct idea stated on neither type of evolution</td><td>Two or more correct ideas stated on either of the evolution types</td><td>Correct comparison provided for the same feature in both evolution types</td><td></td></tr>
<tr><td>4.5a</td><td>1</td><td>Sexual selection
• is a mode of natural selection where members of one biological sex choose mates of the other sex to mate with (intersexual selection), and compete with members of the same sex for access to members of the opposite sex
• a special type of natural selection in which the sexes acquire distinct forms either because the members of one sex choose mates with particular features or because in the competition for mates among the members of one sex only those with certain traits succeed.</td><td>One correct idea stated</td><td></td><td></td><td></td></tr>
<tr><td>4.5b</td><td>4</td><td>[Q: Discuss the impact of sexual selection on populations using specific examples]
• sexual selection - when males compete and females choose</td><td>One correct idea stated</td><td>Two or more correct ideas stated on sexual selection or impact on</td><td>Two or more correct ideas stated on sexual selection</td><td>Impacts of sexual and effect on population with a</td></tr>
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		over reproduction - *improves population health and protects against extinction, even in the face of genetic stress from high levels of inbreeding.* • *dictates who gets to reproduce their genes into the next generation - so it's a widespread and very powerful evolutionary force.* **IMPACTS** • competition among males for reproduction provides a really important benefit, because it improves the genetic health of populations. • Sexual selection achieves this by acting as a filter to remove harmful genetic mutations, helping populations to flourish and avoid extinction in the long-term. • To be good at out-competing rivals and attracting partners in the struggle to reproduce, an individual has to be good at most things, so sexual selection provides an important and effective filter to maintain and improve population genetic health. • Courtship behaviour and mating signals • Without SS populations accumulate deleterious mutations through a ratcheting effect where each new mutation takes a population closer to extinction. • Sexual selection helps to remove those mutations, enabling populations to persist against the threat of extinction. <u>Examples:</u> To uncover this role of sexual selection, the research team evolved *Tribolium* flour beetles over 10 years under controlled conditions in the laboratory, where the only difference between populations was the intensity of sexual selection during each adult reproductive stage. The strength of sexual selection ranged from intense competition and choice where 90 males competed for reproduction with only 10 females, through to the complete absence of sexual selection, with only single males and females		population	or impact on population and explanation on effect of the impact	reflection on result over time. Appropriate and relevant examples provided

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		in monogamous pairings, where females got no choice and males experienced no competition. <u>IMPACT</u> After seven years of reproduction under these conditions, representing about 50 generations, the study exposed the underlying genetic health of the resulting populations. The team used experimental inbreeding to reveal the relative amount of deleterious mutations that lay hidden in each population. It was found: • populations that had previously experienced strong sexual selection maintained higher fitness and were resilient to extinction in the face of inbreeding - with some populations surviving even after 20 inbreeding generations where a brother was mated with a sister in each generation. • populations that had experienced weak or non-existent sexual selection showed more rapid declines in health under inbreeding - and all went extinct by the 10th generation. Results show that sexual selection is important for population health and persistence, because it helps to purge negative and maintain positive genetic variation in a population.				