Assessment Schedule – 2016

Biology: Demonstrate understanding of genetic variation and change (91157)

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding involves defining, using annotated diagrams or models to describe, and describing characteristics of, or providing an account of, genetic variation and change.	*Demonstrate in-depth understanding* involves providing reasons as to how or why genetic variation and change occurs.	*Demonstrate comprehensive understanding* involves linking biological ideas about genetic variation and change. The discussion of ideas may involve justifying, relating, evaluating, comparing and contrasting, or analysing.

Evidence

<table>
<tr><th>ONE</th><th>Expected Coverage</th><th>Achieved</th><th>Merit</th><th>Excellence</th></tr>
<tr><td>(a)</td><td>RrHh</td><td>• F1 Genotype identified correctly.</td><td></td><td></td></tr>
<tr><td>(b)</td><td>
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<tr><td></td><td>RH</td><td>Rh</td><td>rH</td><td>rh</td></tr>
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</td><td>• Punnett square completed with correct gametes and F2.</td><td></td><td></td></tr>
<tr><td>(c)</td><td>Phenotype ratios:
9 red healthy
3 red, lesion / unhealthy
3 white healthy
1 white lesions</td><td>• Phenotype ratio linked with appearance correct.</td><td></td><td></td></tr>
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(d)	Meiosis is type of cell division / reduction division that produces sex cells / gametes / sperm and eggs with half the number of chromosomes / haploid (as the body cell / parent cell / somatic cell) The process of **independent assortment** is where the **homologous pairs** line up in a **random** / different order manner along the cell centre / equator Therefore, only one chromosome from each homologous pair is placed in the gametes. Therefore, genetic variation is achieved / increased when the chromosomes pairs are separated because each new cell has a different combination of chromosomes / allele from each. During **segregation**, only one chromosome from each homologous / pair is placed into the new cells / gametes made. During gamete formation alleles for each gene segregate / separate from each other so that each gamete carries one allele per gene. Therefore, genetic variation is achieved / increased because each new cell has a different combination of alleles from each other and **only ½ the chromosomes** as the parent cell. **Crossing over** is the exchange of **alleles** / **segments** of chromosomes / segments of DNA between homologous / pairs chromosomes / non-sister **chromatids /** accept **annotated** diagram. Therefore, the resulting gametes have chromosomes with different combinations of alleles from each other. In contrast to parent cells, the gametes now have chromosomes with **different combinations of alleles** that were not in the parent / germ cells. (**Do not** accept different combinations of genes.)	• Describes meiosis. • Describes meiosis produces sex cells / sperm / eggs / pollen. • Describes independent assortment. • Describes segregation. • Describes crossing over.	• Explains that independent assortment results in only one chromosome from each homologous pair going into each gamete; therefore, each gamete has different combination of chromosomes. • Explains that segregation results in only one allele from each gene pair going into each gamete, therefore each gamete has different combination of alleles. • Explains that crossing over results in gametes with different combinations of alleles from each other. • Explains crossing over / independent assortment / segregation increase genetic variation (unique traits / characteristics). • Explains that gametes are genetically different from parents – e.g. ½ number of chromosomes **or** chromosomes have different combinations of alleles.	• Through discussion, contrasts gametes produced with parent / germ cell in terms of genetic variation produced by **BOTH crossing over** (chromosomes with different combinations of alleles from parent chromosome) and **independent assortment** / **segregation** (gametes have only ½ the number of chromosomes as parents). Link to the processes is needed. • Discusses link to how gametes are similar to parent cells e.g. the actual alleles are the same / no new genetic information, but allele combinations are different.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes any FOUR statements from Achievement.	Explains any TWO statements from Merit.	Explains any THREE statements from Merit.	Discusses FIRST criterion for Excellence.	Discusses BOTH criteria for Excellence.

TWO	Expected Coverage	Achieved	Merit	Excellence
	Gene pool is sum total / all the alleles available to a population. **Mutation** is a permanent change in DNA sequence / genetic material / genome / gene. Mutation is the original / ultimate source of variation **because** it introduces totally new alleles to a population. Therefore, mutations increase genetic variation in a species. There is variation of *phenotypes* and *genotypes* in a species. Natural selection is the process where individuals with 'fit' phenotypes survive and reproduce more than less fit phenotypes. These fit individuals pass the favourable alleles for these phenotypes onto the next generation. (*Accept*: Variation of alleles within a population, those individuals with favourable alleles will survive and reproduce). The fit alleles, in the case of the moa, are alleles for large body mass (LBM). During the ice age the LBM allele arose by mutation and was present in small frequency / number. Moas with larger bodies retained heat better, thus survived the cold better and therefore reproduced / reproductive success more than moas with smaller bodies. This passed the LBM allele onto the next generation. Therefore, the allele for LBM increased in frequency and became (fixed) in the gene pool, whereas the alleles for smaller bodies decreased in frequency. Therefore, most of the moa had large bodies during the ice age. A large body takes a lot of food to support. Smaller moa would have needed less food than large moa to survive and reproduce successfully. Therefore, the small body allele is favoured in warmer climates, and this allele becomes more frequent as small-bodied moa survive and reproduce more in warm climates. (*Logical to accept small size with better heat dispersal / large size with overheating in warm climate*.)	• Describes gene pool. • Describes mutation. • Describes how mutation affects genetic variation. • Describes natural selection. • Describes that moa with large body mass increase in frequency / small body mass decreases in frequency in cold weather.	• Explains how mutations affect genetic variations. • Explains how natural selection affected body mass in the gene pool. • Uses data from the graph to support an explanation. • Explains that original gene pool must have had both large and small body alleles. • Explains mutation as source of large body allele OR states that large body allele was present but in low frequency. • Explains how moa returned to smaller mass when climate warmed.	• Comprehensively discusses the process of natural selection and how it led to **BOTH** large and small body mass in moa. Must link increased large body ***allele / mutation*** **frequency** in gene pool with more moas with large bodies in population. • Discusses why small body mass returned once the climate warmed again – e.g. less food required for small moa to reproduce and successfully raise young, therefore small were better competitors / heterozygous concept / high SA:Vol in smaller moas an advantage due to being able to cope better with warm climate.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes FOUR statements from Achievement.	Explains any TWO statements from Merit.	Explains THREE statements from Merit.	Discusses ONE criteria for Excellence.	Discusses BOTH criteria for Excellence.

THREE	Expected Coverage	Achievement	Merit	Excellence
	Genetic diversity is variations in genetic make-up / genotypes / total number of genetic characteristics in a species / population / genome / gene pool **OR** Having many different combinations of alleles may offer a survival advantage to a species if conditions change. In small island populations, there is the possibility of inbreeding and this can lead to low diversity. In large populations, there are more individuals therefore greater chance of random mating which will result in greater diversity. **Genetic drift: Chance** / **random /** sudden change in allele frequency of a population. Allele frequency in a small population is more affected / large population is less affected by genetic drift. In a small population, accidental / natural mortality / death can have a larger proportional effect / more likely to lead to alleles becoming fixed / lost / reduced variation in population. **OR** In a large population, accidental / natural mortality / death is less likely to lead to alleles becoming fixed / lost due to the (buffer effect) of the larger number of individuals; therefore tend to have more genetic variation. **Migration:** The movement of individuals / alleles from one population to another population / gene pool. (immigration the movement of individuals into the gene pool; emigration is the movement of individuals out of a gene pool). Allele frequency in a population is affected by migration by adding / subtracting alleles through immigration / emigration of individuals. This especially affects smaller populations, as allele frequency changes due to immigrant or emigrant individuals may not be representative / typical of those of the overall gene pool In the case of the takahe, the (founding) birds introduced (by humans) to the island might not carry all of the alleles of the mainland gene pool. Therefore, the island population will have	• Describes genetic diversity. • Describes genetic drift. • Describes migration. • Describes how allele frequency is affected by genetic drift. • Describes how allele frequency is affected by migration.	• Explains why small island populations may develop low diversity. • Explains why larger populations may have higher diversity. • Explains how allele frequency is affected by genetic drift. • Explains how allele frequency is affected by migration.	• Through discussion compares how **migration** affects **both** small and mainland populations. • Through discussion compares how **genetic drift** affects both small and mainland populations. *Must use takahe or other flightless bird as the example.*

	a reduced genetic diversity (founder effect). Larger populations (mainland) tend to have higher genetic variation because they have proportionally more individuals. Since the takahe is flightless, migration can't take place naturally. Therefore, there is no opportunity to add new alleles or increase allele frequencies in the island by individuals moving from one takahe population to another. At the same time, takahe can't leave the island, so there won't be a loss of alleles through emigration. However, there will still be a loss of alleles OR alleles becoming fixed / established through genetic drift / chance events, because the loss of one individual's alleles is proportionally larger in a small population and therefore has a larger impact on small / island populations compared to mainland / large population. Therefore, the island population would have decreased genetic diversity compared to larger mainland populations.			

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 12	13 – 18	19 – 24