Assessment Schedule – 2019

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

Achievement Criteria

Evidence

<table>
<tr><th>Q</th><th>Expected Coverage</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr>
<td>ONE
(a)

(b)

(c)</td>
<td>Parental gametes BR and br.
F1 Genotype – BbRr

<table>
<tr><td></td><td>BR</td><td>Br</td><td>bR</td><td>br</td></tr>
<tr><td>BR</td><td>BBRR</td><td>BBRr</td><td>BbRR</td><td>BbRr</td></tr>
<tr><td>Br</td><td>BBRr</td><td>BBrr</td><td>BbRr</td><td>Bbrr</td></tr>
<tr><td>bR</td><td>BbRR</td><td>BbRr</td><td>bbRR</td><td>bbRr</td></tr>
<tr><td>br</td><td>BbRr</td><td>Bbrr</td><td>bbRr</td><td>bbrr</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Phenotype ratios:.
9 brown body, red eyes.
3 brown body, brown eyes.
3 black body, red eyes.
1 black body, brown eyes</td>
<td>• Parental gametes AND F1 Genotype identified correctly.

• Punnett square completed with correct gametes and F2.

• Phenotype ratio linked with appearance correct.</td>
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</table>

(d)	Linked genes / alleles are found on the same chromosome, therefore are more likely to be inherited together. Genes that are closer together on the same chromosome are more likely to be linked than genes found further apart, because they will stay together during crossing over. Unlinked genes are found on different chromosomes. Genes that are found further apart are more likely to be unlinked, because they will not stay together during crossing over. Crossing over is the exchange of alleles / segments of chromosomes / segments of DNA between homologous pairs chromosomes / accept annotated diagram. Crossing over can reshuffle / create new allele combinations of unlinked genes. During segregation, only one chromosome from each homologous / pair is placed into the new cells / gametes made. Therefore, during gamete formation, alleles for each gene segregate / separate from each other so that each gamete carries one allele per gene. Segregation doesn't affect / separates linked genes and they will be inherited together / end up in the same gamete. Segregation leads to / creates new combinations of alleles for unlinked genes. Crossing over can separate linked genes. Linked genes occur on the same chromosome and are inherited together. Crossing over exchanges alleles between homologous / pairs of chromosomes, therefore new combinations of alleles result. Crossing over exchanges alleles between homologous / pair chromosomes, therefore genes that are linked (on the same chromosome) can be separated (if the chiasma is located between the two genes). Genes found far away from each other on the same chromosome are likely to be separated via crossing over, due to the large distance between their loci. This means that they will be pulled apart via the process of segregation, and the alleles will end up in different gametes and will therefore not be inherited together. Although the body colour and eye colour are on the same chromosome, they are considered unlinked because they are found far apart and do not stay together during crossing over. However, body colour and wing length are found on the same chromosome and close together, therefore they stay together during crossing over and are considered linked.	• Describes a linked gene. • Describes unlinked genes. • Describes crossing over. • Describes segregation. • Describes a gene.	• 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 how crossing over affects linked genes. • Explains how crossing over affects unlinked genes. • Explains how segregation affects linked genes. • Explains how segregation affects unlinked genes. • Explains why body colour and eye colour are considered unlinked AND / OR body colour and wing length are considered linked.	• Discusses why body colour and eye colour are considered unlinked but body colour and wing length are considered linked. • Discusses with justified reasons why genes on the same chromosomes can be both linked and unlinked.

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.	Provides the criteria for Excellence for any ONE bullet point.	Provides the criteria for Excellence for any TWO bullet points.

Q	Expected Coverage	Achievement	Merit	Excellence
TWO	**Allele frequency** is the % / number of each allele in a gene pool. **Gene pool** is sum total / all the alleles available to a population. **Migration:** The movement of individuals / alleles from one population to another population / gene pool. (Immigration is 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. Immigration increases allele frequency while emigration decreases allele frequency, which leads to increase/decrease of genetic diversity. **Genetic drift** is the chance / random change in allele frequency of a population. Allele frequency decreases as alleles being lost or certain allele frequency increasing fixing the allele within the gene pool, which leads to a decrease in genetic diversity due to events such as random non-mating / disasters/catastrophes / human devastation Kārearea gene pool / population small, hence effect of migration and genetic effect would be more significant Selection pressures are abiotic or biotic factors that will affect the survival of an organism in its environment. Selection pressures acting on the North Island kārearea are the warm temperature and the dense vegetation, and the South Island are the cold temperature and the open plain environment. Natural selection – some phenotypes / traits / individuals are better suited to the environmental conditions. These individuals survive and reproduce, passing on their more favourable alleles to the next generation. Better suited alleles increase in frequency OR less suited alleles decrease in frequency. Those individuals with phenotypes better suited to the environment have an increased chance of survival and reproduction / produce (more) offspring / implies new generations OR those individuals with phenotype less suited to the environment have a decreased chance of survival and reproduction / less offspring. An allele that is not favourable will be selected against, due to the individual's chances of survival and reproduction being reduced so allele frequency decreases OR an	• Describes gene pool. • Describes allele frequency. • Describes migration. • Describes genetic drift. • Describes phenotype / defines phenotype. • Describes natural selection. • Defines selection pressure. • Describes any two selection pressure from either North or South Island.	• Explains migration. • Explains genetic drift. • Explains natural selection. • Explains why kāarearea have a larger size in the South Island (phenotype matched to survival advantage). • Explains why kārearea have a smaller size in the North Island (phenotype matched to survival advantage).	• Comprehensively discusses how migration and genetic drift change allele frequencies in the kārearea gene pool. • Comprehensively discusses the selection pressures that drive natural selection and how it led to the different phenotypes seen in the North and South Islands. Uses data from the table to support a discussion.

	allele that is favourable will be selected for due to the individual's chances of survival and reproduction increasing so allele frequency increases. Gene flow occurs between the North and South Island populations. Females migrate to new areas and introduce alleles. However, the phenotypes are different due to different selection pressures. Large body size (allele) is beneficial in the South Island because: the temperature is lower and enables the kārearea to retain heat and increase survival / they live in an open habitat, which means they do not physically have to be small to manoeuvre around trees, therefore wings can grow larger, which increases ability to get food / reproduce. This beneficial phenotype obtains more nutrients and survives / reproduces passing on the beneficial phenotype and the allele being retained in the population. In contrast, the smaller body size is beneficial to the North Island kārearea because: they live in a native forest habitat and being smaller is an advantage when flying and hunting for prey because they can manoeuvre around trees / the temperature is high and enables them to stay cooler. This beneficial phenotype allows the bird to obtain more nutrients / increases survival in this habitat, therefore the alleles are retained and passed onto the next generation.			

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<tr>
<td>THREE.
(a)</td>
<td>Multiple alleles are alleles of which there are more than two alternatives available at one locus / for one gene.</td>
<td>• Describes multiple allele.</td>
<td></td>
<td></td>
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<tr>
<td>(b)</td>
<td>Co-dominance is a form of dominance where the alleles of a gene pair in a heterozygote are both fully expressed. This results in offspring with a phenotype that is neither dominant nor recessive. 3 possible phenotypes and 3 genotypes.
Recessive inheritance is when a recessive phenotype is expressed only when there are two copies of the recessive allele / the dominate allele is absent. 2 possible phenotypes with 3 three genotypes.</td>
<td>• Describes co-dominance.
• Describes recessive inheritance.</td>
<td>• Explains co-dominance.
• Explains recessive inheritance.</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>
<table>
<tr><td></td><td>P^C</td><td>P^+</td></tr>
<tr><td>P^C</td><td>$P^C P^C$</td><td>$P^C P^+$</td></tr>
<tr><td>P^+</td><td>$P^C P^+$</td><td>$P^+ P^+$</td></tr>
</table>
1:2:1.
$P^C P^C$: $P^C P^+$: $P^+ P^+$.
3:1.
Crescent: No Spot.

<table>
<tr><td></td><td>P^C</td><td>P^D</td></tr>
<tr><td>P^C</td><td>$P^C P^C$</td><td>$P^C P^D$</td></tr>
<tr><td>P^D</td><td>$P^C P^D$</td><td>$P^D P^D$</td></tr>
</table>
1:2:1.
$P^C P^C$: $P^C P^D$: $P^D P^D$.
1:2:1.
Crescent: Crescent & Dot: Dot
</td>
<td>• Correct Punnet square AND genotype / phenotype ratio for (c).
• Correct Punnet square AND genotype / phenotype ratio for (c) 2.
• Describes genotype.
• Describes phenotype.</td>
<td>• Both Punnett squares correct with correct genotype and phenotype ratio.</td>
<td></td>
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</table>

(d)	The genotype ratios for the crosses are both 1:2:1 because each Punnett square is crossing individuals that are heterozygous. However, the phenotypes' ratios are different because the alleles are expressed differently. One shows recessive inheritance (3:1) and the other co-dominance (1:2:1). In co-dominance, heterozygous genotype is different to both of the homozygous genotypes. In co-dominance you see both of the homozygous genotypes expresses in the heterozygous phenotype e.g. crescent and dot. So it depends on what alleles are present as to what phenotype is expressed in the co-dominant heterozygous phenotype C and + will be crescent and no spot, CD will be crescent and dot, D+ no spot and dot. Thus, the phenotype appearance results from the combination of the alleles, not the presence of a dominant allele, as with recessive inheritance. This is compared to recessive inheritance, where you do not see both possible phenotypes expressed in the heterozygote, only the dominant (homozygous dominant genotype) phenotype. Hence three genotypes and only two phenotypes, and the dominant phenotype results from both homozygous dominant or the heterozygous phenotype. The advantages of multiple alleles within a species means more phenotypes are expressed and therefore more different phenotypes can respond to natural selection pressures and increases the chances of survival of species (especially if environmental conditions change).		• Explains why genotype are the same but phenotype ratios are different. • Explains an advantage of multiple alleles to a species. • Gives ONE example of the different phonotypes the different allele combinations give for heterozygous phenotype. • Explains all possible combinations.	• Discusses why the genotype ratios are the same but phenotypes ratios are different. • Discusses advantages of multiple alleles to a species. • Compares recessive and co-dominance phenotype ratios and relates to the possible inheritance pattern of platyfish.

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24