Assessment Schedule – 2015

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

Assessment 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

Q	Expected Coverage	Achievement	Merit	Excellence
ONE (a) (b) (c)	**Gene pool** is (all) the genes or alleles (held by the individuals) in a population. **Genetic drift**: Chance/random change in allele frequency of a population. Genetic drift has affected NZ black robin population because it is a small population where relatively small changes in allele numbers can have a big impact on the frequency of alleles in the total population. **Allele** is two or more alternative forms of a gene. **Allele frequency** is the % / number of each allele in a gene pool. **Natural selection** is where individuals with alleles most favourable to the environment will survive and reproduce and pass these favourable genes to their offspring. Within a population there is **variation** in alleles / genes. Therefore, only individuals with genes that are most **suited** to the environment will **reproduce and pass genes** on to the next generation. **Non favourable** alleles will be **lost** from the population because individuals possessing them will have reduced reproduction and survival. **Selection pressure** is a biotic or abiotic factor/agent/environment factor that affects the survival of an organism and therefore influences **reproductive success** in a (proportion of a) population. Within the black robin population there is **variation** in the behaviour of egg laying. Individuals with the allele / for laying eggs inside nests are more favoured because their eggs are incubated and hatch successfully, therefore these **alleles are passed on** to their offspring. However, a small number of eggs are laid on the rim of nests and are not incubated or hatch successfully, therefore these **alleles are not passed on** to offspring. Humans started pushing rim eggs into the cen-	• Describes gene pool. • Describes genetic drift. • Describes allele. • Describes allele frequency. • Describes natural selection. • Describes selection pressure.	• Explains how genetic drift affects black robin population. • Explains natural selection. • Explains selection pressure. • Explains why rim laying behaviour increased. (why genes / alleles are passed on to the offspring / next generation). • Explains why rim laying behaviour then decreased when intervention stopped. (why genes / alleles are not passed on to the next generation).	• A discussion of natural selection using example. • A discussion of why rim laying **increased** with human intervention **then decreased** once the intervention stopped.

	tre of nests. Consequently, this selection pressure increased offspring survival and rim laying behaviour. Once humans stopped pushing eggs into nests, this allele was reduced in the population because eggs carrying it were not incubated and offspring did not pass the allele on, as this allele was not favourable to the environment and did not increase the black robins' chance of survival and thus reproduction.			

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

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

(c)</td>
<td>Multiple alleles – more than two alleles for one gene.
Child 1 has two possible genotypes because it is not known what its father's genotype is. B is dominant over O, so will be expressed in heterozygous child. The child could inherit B from mother and O from father or one B from mother and B from father.
Child 2 has only one genotype because it is AB – A gamete comes from mother, and B gamete comes from father.

<table>
<tr><td></td><td>O</td><td>O</td></tr>
<tr><td>A</td><td>AO</td><td>AO</td></tr>
<tr><td>B</td><td>BO</td><td>BO</td></tr>
</table>

Possible phenotypes are blood group A and blood group B.
Dominance: is the interaction between alleles of one gene. One dominant allele is expressed over a second recessive allele at the same locus.
Co-dominance: A allele and the B allele are equal in their dominance and will be expressed equally if they are paired together into the genotype $I^A I^B$.
Neither the A allele or the B allele is dominant over the other, so each type is expressed equally in the phenotype giving the human an AB blood type.
None of the children will have blood group O or AB because the mother is homozygous O, therefore produces only O gametes.
The father is AB; therefore produces half A gametes and half B gametes. When the egg and sperm fertilise there is a 50% chance that an O egg will be fertilised by an A gamete or B gamete.</td>
<td>• Describes what multiple alleles are.
• Describes one parent's genotype
• Monohybrid Punnett squares showing possible genotype of child 2.
• Describes possible phenotypes AND genotypes of the offspring for (c) or Punnett square with phenotype.
• Describes dominance.
• Describes co-dominance.</td>
<td>• Explains why child 1 has TWO possible genotypes (needs to mention alleles of gametes from BOTH parents)
• Explains why child 2 has only one possible genotype. (needs to mention alleles of gametes from BOTH parents).
• Explains dominance with Blood type allele example.
• Explains co-dominance with Blood type allele example.</td>
<td>• Discusses why none of their children will have the blood group O or AB
(Clear link to parental gametes).
• Links explanations of dominance and co-dominance to discuss why there is no O or AB phenotypes.
• Discussion is supported by reference to parental genotypes and genotype ratios / percentages of offspring.</td>
</tr>
</table>

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Provides any ONE state-ment from Achievement.	Provides any TWO statements from Achievement.	Provides any THREE statements from Achievement.	Provides any FOUR statements from Achievement.	Provides any TWO explanations from Merit.	Provides any THREE explanations from Merit.	Provides ONE of the criteria for Excellence.	Provides TWO from criteria for Excellence.

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<td>THREE
(a)

(b)

(c)</td>
<td>Lethal allele: an allele that produces a phenotypic effect that causes the death of the organism (at any stage of life).

Heterozygous: one dominant allele and one recessive allele, e.g. Yy.
Homozygous: either two recessive alleles or two dominant alleles, e.g. yy or YY.
Test crosses are used to test an individual's genotype by crossing it with an individual of a known genotype.
The mice that show the recessive phenotype are known to have a homozygous recessive genotype. The mice that show the dominant phenotype, however, may be either homozygous dominant or heterozygous. The phenotypically dominant organism is the individual in question in a test cross. The purpose of a test cross is to determine if this individual is homozygous dominant or heterozygous.
Test cross with yellow and yellow shows 2:1 ratio.
Yellow mice were crossed with grey mice. All test crosses with the yellow mice give a 1:1 ratio. Therefore, all of the yellow mice from the cross of two heterozygous yellow mice are Yy.
May use correct monohybrid Punnett squares to show ratios. Discusses that the difference in the expected ratio and the actual ratio is due to the death of pure breeding yellow mice as a result of lethal gene interaction
First cross – test cross
<table>
<tr><td></td><td>y</td><td>y</td></tr>
<tr><td>Y</td><td>Yy</td><td>Yy</td></tr>
<tr><td>y</td><td>yy</td><td>yy</td></tr>
</table>
50% yellow, 50% grey.

Second cross –
<table>
<tr><td></td><td>Y</td><td>y</td></tr>
<tr><td>Y</td><td>YY</td><td>Yy</td></tr>
<tr><td>y</td><td>Yy</td><td>yy</td></tr>
</table>
Expected 3:1, however results show 2:1.
Mutation: (permanent) change in the (base sequence of) DNA/RNA/gene.
Gametic mutation forms a new allele in sperm / eggs / ovum / pollen that can be passed onto the offspring, whereas somatic mutation forms a new (but not always) allele in a body cell which may affect the individual, but cannot be passed on to the offspring.
The cystic fibrosis allele remains in the population because the cystic fibrosis allele is recessive, therefore heterozygous individuals are carriers. They are not affected, and reproduce, passing the allele on. When two carriers produce</td>
<td>• Describes a lethal allele.
• Describes heterozygous AND describes homozygous.
• Describes a test cross.
• Describes mutation.
• Describes somatic mutation (must mention body cell OR is not inherited).
• Describes gametic mutation(must mention sex cells OR inherited).</td>
<td>• Explains how test crosses are used to determine genotype (explains two crosses).
• Explains somatic mutation (must mention body cell AND is not passed on).
• Explains gametic mutation (must mention sex cells AND inherited).
• Explains why cystic fibrosis remains in population.</td>
<td>• A discussion of how Cuénot used the test crosses to determine the live yellow mice were heterozygous (discusses two crosses and links why 3:1 becomes 2:1 by linking to the death of YY).
• A discussion why the cystic fibrosis lethal allele remains in the human population (link to the 25% / punnett square / inheritance of 2 homozygous alleles).</td>
</tr>
</table>

	offspring there is a 25% chance their offspring will be homozygous recessive and show the cystic fibrosis phenotype. Could support answer with a Punnett square.			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24