Assessment Schedule – 2018

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

Evidence

<table>
<tr><th>Q</th><th>Expected Coverage</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr><td>ONE
(a)</td><td>AaHh</td><td>• F1 genotype identified correctly.</td><td></td><td></td></tr>
<tr><td>(b)</td><td>
<table>
<tr><th></th><th>AH</th><th>Ah</th><th>aH</th><th>ah</th></tr>
<tr><td>AH</td><td>AAHH</td><td>AAHh</td><td>AaHH</td><td>AaHh</td></tr>
<tr><td>Ah</td><td>AAHh</td><td>AAhh</td><td>AaHh</td><td>Aahh</td></tr>
<tr><td>aH</td><td>AaHH</td><td>AaHh</td><td>aaHH</td><td>aaHh</td></tr>
<tr><td>ah</td><td>AaHh</td><td>Aahh</td><td>aaHh</td><td>aahh</td></tr>
</table>
</td><td>• Punnett square completed with correct gametes and F2.</td><td></td><td></td></tr>
<tr><td>(c)</td><td>Phenotype ratios:
9 agouti (tabby), short hair
3 agouti (tabby), long hair
3 non-agouti (black), short hair
1 non-agouti (black), long hair.</td><td>• Phenotype ratio linked with appearance correct.</td><td></td><td></td></tr>
</table>

(d)	In diploid (2n) organisms / parent cells of meiosis / body cells, the genome is composed of homologous chromosomes. One chromosome of each homologous pair comes from the mother (called a maternal chromosome) and one comes from the father (paternal chromosome). Homologous chromosomes are similar, but not identical. Each carries the same genes in the same order, but the alleles for each trait may not be the same. Meiosis is a 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). **Crossing over** is the exchange of **alleles** / **segments** of chromosomes / segments of DNA between homologous chromosomes **/** accept **annotated** diagram. Crossing over can only take place between homologous chromosomes because they share the same genes at the same loci / location on the chromosomes / same length. Therefore, each new cell has a different combination of alleles from each other which increases genetic variation. The process of **independent assortment** is where the **homologous pairs** line up in a **random** / different order / manner along the cell centre / equator. **Since** only one chromosome from each **homologous pair** is placed in the gametes, each new cell has a different combination of chromosomes / allele. Therefore, genetic variation is achieved / increased. During **segregation**, only one chromosome from each **homologous** pair / pairs of alleles is placed into the new cells / gametes made. Homologous chromosomes separate and migrate to the cells poles during meiosis. 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 half the chromosomes** of the parent cell. Parent cells of meiosis are diploid (2n / 46), so have homologous chromosomes. During meiosis, homologous chromosomes are used to increase genetic variation, so each gamete is genetically different. The process of meiosis reduces the diploid cell to a haploid cell / a gamete, which contains only one copy of each gene / chromosome (n / 23). When gametes fuse during fertilisation each haploid cell brings one copy of each chromosome thereby restoring homologous chromosomes upon fertilisation.	• Describes homologous chromosome. • Describes meiosis. • Describes independent assortment. • Describes segregation. • Describes crossing over. • Describes genetic variation. • Describes parental / diploid cells. • Describes daughter / haploid cells.	• Explains a homologous chromosome. • 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 – eg half number of chromosomes **or** chromosomes have different combinations of alleles.	• Thorough discussion, contrasts homologous chromosomes' involvement (purpose) in independent assortment, segregation and crossing over • Discusses how AND why homologous chromosomes increase genetic variation in daughter cells. • Discusses link between why parent cells have homologous chromosomes, and why gametes do not.

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 any ONE criterion for Excellence.	Discusses any TWO criteria for Excellence.

Q	Expected Coverage	Achievement	Merit	Excellence
TWO	An allele is a different version of a gene. Allele frequency: number / amount / percentage of **each / an** allele in a population / gene pool. Bottleneck: sudden / catastrophic / rapid / drastic reduction in size of a population / gene pool. Allele frequency in a population is affected by genetic bottleneck by loss of alleles or resulting in an unrepresentative gene pool. Genetic drift: **chance / random** change in allele frequency of a population / gene pool. Alleles could become fixed / 100% / established or lost / 0% through genetic drift / chance events. 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. Allele frequency in Māui population is more affected by genetic drift because in Māui population, accidental / natural mortality / death can have a larger proportional effect / more likely to lead to alleles becoming fixed / lost / reduced variation in population. Whereas in Hector's 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. The Māui population has gone through a genetic bottleneck which has affected allele frequencies because the individuals may not be representative / typical of those of the overall gene pool. Therefore, the Māui population would have decreased genetic diversity compared to the Hector's population. In Māui population, there is the possibility of few individuals breeding or mating / inbreeding and this can lead to low diversity. In Hector's population, there are more individuals therefore greater chance of **random mating** which will result in greater diversity Or Hector's population would have higher genetic variation because they have proportionally more individuals. Interbreeding Māui and Hector's populations may add new alleles / new combination or increase allele frequencies in the Māui population. At the same time, new alleles would be introduced into the Hector's population. However, interbreeding could reduce the unique allele frequency (genetic diversity) of the Māui subspecies and potentially eliminate the subspecies.	• Describes an allele. • Describes allele frequency. • Describes bottleneck. • Describes genetic drift. • Describes genetic diversity.	• Explains how allele frequency is affected by genetic bottleneck. • Explains how allele frequency is affected by genetic drift. • Explains why small Māui population may have low genetic diversity / low diversity of alleles. • Explains why larger Hector's population may have higher genetic diversity / higher allele diversity. • Explains how interbreeding may affect Māui / Hector's population.	• Comprehensively discusses how genetic bottleneck has affected the allele frequency in Maui's dolphin • Comprehensively discusses how genetic drift affects both (small and large) populations. • Discusses how interbreeding might affect allele frequency of both populations.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
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Q	Expected Coverage	Achievement	Merit	Excellence
THREE (a)	Lethal allele: allele that causes death. Recessive lethal allele: organism that is homozygous recessive / two copies of the recessive allele dies.	• Describes lethal allele.		
(b)	Co-dominance – alleles of a gene in heterozygotes are fully expressed. Resulting phenotype equally expresses each / both allele / phenotype that is neither dominant nor recessive. OR Homozygous dominant / RR produces a normal blood cell phenotype / all blood cells are normal. Heterozygous / Rr produces normal blood cells and sickle cells / half blood cells are normal shape and half are sickle shaped. Homozygous recessive / rr produces a sickle cell phenotype / all blood cells are sickle shaped. Rr – produces both sickle and normal red blood cells / mixture of both / rr produces only sickle-shaped blood cells.	• Describes co-dominance. • Describes Rr and rr phenotypes.		
(c)	Natural selection is where individuals with alleles most favourable to the environment will **survive and reproduce** and pass these favourable alleles to their offspring. Within a population there is variation in alleles. Therefore, only individuals with alleles that are most suited to the environment will reproduce and pass favourable alleles on to the next generation. Non-favourable alleles will be lost from the population because individuals possessing them will have reduced reproduction and survival. The homozygous recessive phenotype produces all sickle cells and is lethal / can cause death. Therefore, when an individual has two mutated alleles (rr), the individual has symptoms of sickle cell disease and most likely dies, and alleles are lost from the population. The homozygous phenotype RR produces all normal blood cells and causes the production of healthy haemoglobin. However, in malarial areas, this genotype is selected against as it does not kill malarial cells, so individuals do not survive & pass on their R alleles. Rr – the mutated sickle cell allele (r) is favourable in an environment exposed to malaria. Individuals with the sickle cells and normal (co-dominant) are more likely to survive because they can carry sufficient oxygen. The heterozygotes survive and reproduce, passing on the beneficial allele, and therefore the allele is retained in the **population in malarial areas** Sickle cell is a recessive lethal condition, so only individuals that have two recessive alleles will die. Individual heterozygote, who 'carry' the recessive allele, can pass the allele on to the next generation because they produce sickle shaped cells which have low potassium levels that kill the parasite, but the R allele also produces normal blood cells, so the individual can still transport oxygen. Therefore, the allele is retained in the population by 'heterozygous carriers'.	• Describes natural selection. • Describes that heterozygous genotype is selected for / has a survival advantage in malarial areas.	• Explains natural selection. • Explains natural selection using sickle cell phenotype(s). • Explains heterozygote advantage (in malarial zones / malaria) • Explains how lethal alleles can be 'carried' by individuals (co-dominant). • Explains how / why sickle cell allele is retained in the population.	• Discusses natural selection using sickle cell phenotypes. • Comprehensively discusses with justified reasons why the recessive lethal allele remains in the population.

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 – 6	7 – 12	13 – 18	19 – 24