

**Assessment Schedule – 2015**

**Science: Demonstrate understanding of biological ideas relating to genetic variation (90948)**

**Evidence Statement**

Question	Evidence			Achievement		Merit		Excellence																			
<p>ONE (a)  (b)  (c)</p>	<p>Genotype albino rat aa Genotype heterozygous black rat Aa Gametes a, a, A, a Genotypes of offspring Aa, Aa, aa, aa (or heterozygous, homozygous recessive) Rat 4 aa/ homozygous recessive Rat 6 Aa /heterozygous Rat 10 Aa /heterozygous The black Rat 3 must have at least 1 dominant A allele because its phenotype is black. However there are two possible genotypes AA or Aa. These genotypes could result in the following crosses:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border-right: 1px solid black; border-bottom: 1px solid black;"></td> <td style="border-bottom: 1px solid black;">A</td> <td style="border-bottom: 1px solid black;">A</td> <td style="border-right: 1px solid black; border-bottom: 1px solid black;"></td> <td style="border-bottom: 1px solid black;">A</td> <td style="border-bottom: 1px solid black;">a</td> </tr> <tr> <td style="border-right: 1px solid black;">a</td> <td>Aa</td> <td>Aa</td> <td style="border-right: 1px solid black;">a</td> <td>Aa</td> <td>aa</td> </tr> <tr> <td style="border-right: 1px solid black;">a</td> <td>Aa</td> <td>Aa</td> <td style="border-right: 1px solid black;">a</td> <td>Aa</td> <td>aa</td> </tr> </table> <p>The pedigree tree provided shows that all the actual offspring were black; therefore the most likely genotype for Rat 3 is AA, as this can only produce black offspring. However these Punnett squares only show the probability of an event occurring. The Aa / aa cross can also produce black offspring. It may just be chance that aa offspring were not produced. To be certain of the genotype of the black Rat 3, you would have to carry out many more crosses with the aa parent. If, after a LARGE number of crosses, there were no white offspring you would have confidence the rat was AA, but only one white offspring will prove Aa.</p>				A	A		A	a	a	Aa	Aa	a	Aa	aa	a	Aa	Aa	a	Aa	aa	<ul style="list-style-type: none"> <li>• Identifies albino rat as aa and heterozygous rat as Aa OR completes all gametes (a,a, A,a)</li> <li>• Gives genotypes of the four offspring as Aa, Aa, aa, aa (could give follow on if used AA instead of Aa).</li> <li>• Identifies 2 genotypes.</li> <li>• Identifies the 2 possible genotypes for Rat 3 as AA or Aa.</li> <li>• Completes two Punnett squares which compare an Aa / aa cross with an AA / aa cross</li> </ul>		<ul style="list-style-type: none"> <li>• Explains that the rat must have an A allele to be black.</li> <li>• Completes two Punnett squares which compare an Aa / aa cross with an AA / aa cross, and explains that in this family pedigree the AA has produced only black offspring.</li> <li>• Explains that you would have to carry out MANY more crosses with aa OR that ANY white offspring proves Aa</li> </ul>		<ul style="list-style-type: none"> <li>• Explains the Rat 3 is <b>more likely</b> to be AA, because ALL the offspring from crossing individuals 3 and 4 were black.</li> <li>• Discusses that although AA is <b>more likely</b> / probable, it is still possible that the black parent was Aa, and by chance aa was not produced.</li> <li>• Discusses that after <b>many</b> crosses, if no white offspring occurred, you would have <b>more</b> confidence that black Rat 3 parent was AA AND if any (one) white offspring were produced that would prove Rat 3 was heterozygous Aa.</li> </ul>	
	A	A		A	a																						
a	Aa	Aa	a	Aa	aa																						
a	Aa	Aa	a	Aa	aa																						
Q1	N0 – no response or no relevant evidence	N1 – 1 point	N2 – 2 points	A3 – 3 points	A4 – 4 points	M5 – 2 points	M6 – 3 points	E7 – 2 points	E8 – 3 points																		

Question	Evidence			Achievement		Merit		Excellence	
<p>TWO (a)</p> <p>(b)</p> <p>(c)</p>	<p>Plain shell is heterozygous for shell pattern.</p> <p>A gene is a length of DNA that codes for a particular characteristic protein such as shell pattern, whereas an allele is an alternative form of a gene. There is one allele for a banded shell and a different allele for a plain shell. The two alleles together make up the gene.</p> <p>The snails have inherited different shell patterns because they have inherited one homologous chromosome from their mother and one from their father. The banded snail is homozygous for shell pattern; therefore each parent must have contributed a banded allele. The plain snail has one plain allele; therefore at least one of the parents must have a plain allele. This means there are two possibilities for the parents: they are either both heterozygous; or one parent is heterozygous and the other is homozygous recessive.</p>			<ul style="list-style-type: none"> <li>• Plain shell is heterozygous for shell pattern because there are two different alleles (N and n) ie reason given</li> <li>• A gene is a length of DNA that codes for a particular characteristic / protein.</li> <li>• An allele is an alternative form of a gene / different sequence of bases.</li> <li>• States that in a homologous pair of chromosomes one chromosome comes from the mother and one comes from the father</li> <li>• Shows correct possible genotypes for parents (Nn, nn) and completes one correct Punnett square (Nn × Nn OR Nn × nn).</li> </ul>		<ul style="list-style-type: none"> <li>• Compares a gene and an allele by defining both terms and refers to the given example.</li> <li>• Explains that because the alleles are different, the snails must have different DNA / sequence of bases.</li> <li>• Explains that each parent must have an allele for the banded (recessive) shell.</li> <li>• Gives correct possible genotypes for parent snails and explains how these genotypes could give the two phenotypes (may or may not use Punnett squares).</li> </ul>		<ul style="list-style-type: none"> <li>• Explains that in a homologous pair, one chromosome has come from the mother and one has come from the father. Discusses that because the banded snail has two banded alleles, each parent must have a banded allele.</li> <li>• Discusses that because the plain snail is heterozygous, at least one of the parents must have an allele for a plain shell.</li> <li>• Discusses that there are two possibilities: the parents could both be heterozygous; or one parent could be heterozygous and the other could be homozygous recessive (or homozygous for banded shell), and explains how this gives rise to both phenotypes.</li> </ul>	
Q2	NØ – no response or no relevant evidence	N1 – 1 point	N2 – 2 points	A3 – 3 points	A4 – 4 points	M5 – 2 points	M6 – 3 points	E7 – 2 points	E8 – 3 points

Question	Evidence			Achievement		Merit		Excellence	
THREE (a)  (b)(i)  (ii)	<p>There is variation in the plants shown in the photograph because the plants have different alleles / DNA / genes. Some alleles / DNA / genes result in a plant that is resistant to a disease but other alleles / DNA / genes result in a plant that is affected by a disease.</p> <p>Sexual reproduction has the following processes that all contribute to variation in the offspring: meiosis / mutations / fertilisation / crossing over / independent assortment/ segregation</p> <p>Sexual reproduction results in variation, which is important in a changing environment. As the environment changes (e.g. drought, diseases, chemicals, pests etc.), some individuals may not survive. If there is variation in their alleles / DNA / genes, some individuals may have phenotypes that are more suited to the environment; therefore they will be more likely to survive. The individuals that survive when they reproduce will pass these alleles / DNA / genes to the next generation, helping to ensure the survival of the species.</p>			<ul style="list-style-type: none"> <li>• Only some plants have inherited resistance to disease.</li> <li>• The plants have different alleles / DNA / genes</li> <li>• Meiosis OR mutations OR fertilisation OR crossing over OR independent assortment/ segregation could lead to variation</li> <li>• A changing environment can cause some individuals to die / not reproduce as much.</li> <li>• Individuals that survive are able to go on to reproduce.</li> </ul>		<ul style="list-style-type: none"> <li>• Links the idea that plants that are resistant to disease have different alleles / DNA / genes from the plants that are affected by the disease.</li> <li>• Meiosis OR mutations OR fertilisation OR crossing over OR independent assortment/ segregation could lead to variation because ... (relevant explanation).</li> <li>• Changing environments can make survival difficult but some individuals will survive and may go on to reproduce.</li> </ul>		<ul style="list-style-type: none"> <li>• Links disease resistance / other example <i>and population survival in a changing environment</i> to genetic variation and the processes that occur during sexual reproduction.</li> </ul>	
Q3	NØ – no response or no relevant evidence	N1 – 1 point	N2 – 2 points	A3 – 3 points	A4 – 4 points	M5 – 2 points	M6 – 3 points	E7 Missing reference to “population survival in a changing environment”.	E8 Full answer

### Cut Scores

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

