

**Assessment Schedule – 2014**

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

**Evidence Statement**

| Question                 | Evidence   |                               |                                | Achievement  |                                | Merit   |                          | Excellence   |                                       |
|--------------------------|--|-------------------------------|--------------------------------|--|--------------------------------|---|--------------------------|--|---------------------------------------|
| ONE<br>(a)<br>(b)<br>(c) | <p>DNA strand TCAG.</p> <p>A gene and an allele are both made of DNA. A gene is a length of DNA that codes for a particular characteristic, whereas an allele is the alternative form of a gene containing a different base sequence. A gene for a characteristic consists of two alleles. The dominant allele gives the phenotype of the gene.</p> <p>The phenotype is the physical characteristic of the plant. Variation that is inheritable is due to differences in the alleles (or genetic material). This comes from meiosis, eg independent assortment / gametes with ½ chromosomes so mix of 2 parents. Non inheritable variation is due to environmental factors. In plants this could be plenty of water or sunlight, enabling the plant to grow taller, or a lack of water limiting the plant’s growth. It is the combination of both the inheritable and non-inheritable factors that determines the phenotype. For example a plant might have two alleles coding for a tall plant, but if there is a lack of water the plant will not grow to its genetic potential. Variation is important because if environmental conditions change, some plants may not be suited to the new conditions and may not survive, but other plants, which are different, may be suited to the new conditions and can survive.</p> |                               |                                | <ul style="list-style-type: none"> <li>Labels strand with FOUR correct bases.</li> <li>Defines an allele (alternative form of a gene / length of DNA).</li> <li>Defines a gene (length of DNA that codes for a particular characteristic).<br/>Gives TWO environmental factors (water / light / nutrients / wind / disease / pests etc).</li> <li>States that inherited variation is due to genes / can be passed on OR non-inheritable due to environment / cannot be passed on.</li> <li>Gives environmental factor linked to characteristic (eg water affects height).</li> <li>States variation is important, as survival in a changing environment is more likely.</li> </ul> |                                | <ul style="list-style-type: none"> <li>Explains relationship between gene and allele.</li> <li>Explains how 2 alleles affect phenotype / characteristics.</li> <li>Gives an example of an environmental factor and explains how it could affect the phenotype / characteristics.</li> <li>Explains how inheritable factors result in variation or survival, ie explains how meiosis gives variation – need mix of 2 parents / favourable or beneficial traits passed on.</li> </ul> |                          | <ul style="list-style-type: none"> <li>Discussion of inheritable <b>and</b> non-inheritable/environmental factors (with example/s) resulting in variation of phenotypes / characteristics.<br/>AND<br/>The significance of the variation in terms of survival of a plant <b>population</b> in <b>changing</b> environmental conditions.</li> </ul> |                                       |
|                          | <b>Not Achieved</b>  |                               |                                | <b>Achievement</b>   |                                | <b>Achievement with Merit</b>   |                          | <b>Achievement with Excellence</b>   |                                       |
| Q1                       | N0 = no response or no relevant evidence   | N1 = 1 point from Achievement | N2 = 2 points from Achievement | A3 = 3 points from Achievement   | A4 = 4 points from Achievement | M5 = 1 point from Merit   | M6 = 2 points from Merit | E7 = Excellence point with minor omission  | E8 = Excellence point fully discussed |

| Question   | Evidence  |                               |                                | Achievement   |                                | Merit   |                          | Excellence   |                                       |
|--|---|-------------------------------|--------------------------------|---|--------------------------------|---|--------------------------|--|---------------------------------------|
| <p>TWO</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)(i)</p> <p>(ii)</p> <p>(iii)</p> | <p>A = meiosis<br/>B = fertilisation</p> <p>egg 23 chromosomes<br/>adult and zygote 46 chromosomes</p> <p>The egg and the sperm both have the same number of chromosomes. This is so that when fertilisation occurs, the chromosomes can exist as pairs. Chromosomes need to be in pairs so that they can separate in meiosis. The zygote and the adult cells are both the same, because every cell in the body needs an identical and full copy of all the genetic information. The number of chromosomes in the gametes is half the number in the body cells, so that when fertilisation occurs, the chromosome number returns to its full number.</p> <p>Genotype – The combination of alleles for each trait.</p> <p>Phenotype – The physical expression of genotype, alleles (the characteristic that is seen), eg blue eyes or brown eyes.</p> <p>The brothers will have inherited half their chromosomes from their mother and half from their father. The actual chromosomes they inherited are due to chance because meiosis (production of gametes) randomly mixes chromosomes, resulting in a new mix of genetic information, and therefore different genotypes and phenotypes. Fertilisation (fusion of parents gametes) is also random, with more variation occurring, depending on which sperm fertilises which egg, and because each sperm and egg are different in terms of which chromosomes are present, more variation is introduced in terms of each zygote having different combinations of chromosomes.</p> |                               |                                | <ul style="list-style-type: none"> <li>Names processes A (meiosis / gamete production) and B (fertilisation or mitosis).</li> <li>Identifies egg has 23 chromosomes and zygote and adult have 46.</li> <li>States sperm and egg have half the number of chromosomes of the zygote OR adult.</li> <li>States that sperm and egg have the <b>same</b> number of chromosomes OR zygote and adult have the same number of chromosomes.</li> <li>Defines the term genotype OR the term phenotype.</li> <li>Defines meiosis OR fertilisation.</li> <li>States that brothers have different genotypes because get different combinations of parents genes / parents gametes vary.</li> </ul> |                                | <ul style="list-style-type: none"> <li>Explains gamete number is half the zygote number / body cell, so that after fertilisation the chromosome number returns to the full number / 2n OR to stop doubling.</li> <li>Explains that meiosis produces gametes that are different due to random shuffling / independent assortment etc.</li> <li>Explains that it is random which egg and sperm fertilise so all offspring have different genotypes.</li> <li>Uses inheritance to explain how different genotypes can arise through different alleles in parents.</li> </ul> |                          | <ul style="list-style-type: none"> <li>Discusses how the two brothers could have different genotypes – ie that sexual reproduction produces a <b>new mix</b> of alleles, because meiosis gives unique gametes AND in fertilisation it is <b>random chance</b> which sperm fertilises the egg.</li> </ul> |                                       |
|  | <b>Not Achieved</b>   |                               |                                | <b>Achievement</b>  |                                | <b>Achievement with Merit</b>   |                          | <b>Achievement with Excellence</b>   |                                       |
| Q2   | N0 = no response or no relevant evidence  | N1 = 1 point from Achievement | N2 = 2 points from Achievement | A3 = 3 points from Achievement  | A4 = 4 points from Achievement | M5 = 1 point from Merit   | M6 = 2 points from Merit | E7 = Excellence point with minor omission  | E8 = Excellence point fully discussed |

| Question  | Evidence   |                               |                                | Achievement  |                                | Merit  |                                    | Excellence   |                               |                     |  |  |                    |  |                               |  |                                    |  |
|---|--|-------------------------------|--------------------------------|--|--------------------------------|--|------------------------------------|--|-------------------------------|---------------------|--|--|--------------------|--|-------------------------------|--|------------------------------------|--|
| THREE   | <p>A white sheep could have genotype AA or Aa, whereas a black sheep can be only aa. To breed a group of white sheep, a breeder should use sheep that are both AA. The breeder can determine if a white sheep is AA by crossing a white sheep with a black sheep. If the white sheep is AA, none of the offspring will be black. The breeder would need to carry out many crosses to show that it was not just due to chance that a black sheep had not been produced. If a black offspring is produced, the breeder can be certain the white parent was Aa. The farmer should breed only with an AA male and white wool females, as this will ensure that all offspring are white. Ideally, the breeder would breed from AA males and AA females, as this would remove the recessive allele from the group.</p> |                               |                                | <ul style="list-style-type: none"> <li>• AA / homozygous dominant and Aa / heterozygous= white and aa / homozygous recessive= black.</li> <li>• Defines pure breeding as homozygous.</li> <li>• Breed from homozygous dominant AA / sheep with no black lambs.</li> <li>• Test cross with homozygous recessive aa / black sheep.</li> <li>• Completes 1 correct Punnett square.</li> </ul> |                                | <ul style="list-style-type: none"> <li>• Compares the results of AA and Aa when crossed with aa by identifying the difference in outcome (with or without a Punnett square).</li> <li>• Explains that a large / reasonable number of offspring need to be produced to be sure a sheep is AA.</li> <li>• Explains that as soon as a black offspring appears, the breeder knows the white sheep is Aa.</li> <li>• Explains that it is important to determine that the male is AA, as the offspring will be white regardless of whether ewes are AA or Aa.</li> </ul> |                                    | <ul style="list-style-type: none"> <li>• For a test cross, explains that a large / reasonable number of offspring need to be produced to be sure a sheep is AA.<br/>AND<br/>Explains that as soon as a black offspring appears, the breeder knows the white sheep is Aa.</li> <li>• Explains that ideally both males and females are AA, AND explains through crosses with aa (black) sheep how this can be determined to give a pure breeding group.</li> </ul> |                               |                     |  |  |                    |  |                               |  |                                    |  |
| <table border="0" style="width: 100%;"> <tr> <td colspan="3" style="text-align: center;"><b>Not Achieved</b></td> <td colspan="2" style="text-align: center;"><b>Achievement</b></td> <td colspan="2" style="text-align: center;"><b>Achievement with Merit</b></td> <td colspan="2" style="text-align: center;"><b>Achievement with Excellence</b></td> </tr> </table> |  |                               |                                |  |                                |  |                                    |  |                               | <b>Not Achieved</b> |  |  | <b>Achievement</b> |  | <b>Achievement with Merit</b> |  | <b>Achievement with Excellence</b> |  |
| <b>Not Achieved</b>   |  |                               | <b>Achievement</b>             |  | <b>Achievement with Merit</b>  |  | <b>Achievement with Excellence</b> |  |                               |                     |  |  |                    |  |                               |  |                                    |  |
| Q3  | NØ = no response or no relevant evidence   | N1 = 1 point from Achievement | N2 = 2 points from Achievement | A3 = 3 points from Achievement   | A4 = 4 points from Achievement | M5 = 1 point from Merit  | M6 = 2 points from Merit           | E7 = 1 point from Excellence   | E8 = 2 points from Excellence |                     |  |  |                    |  |                               |  |                                    |  |

| Question  | Evidence   |                               |                                | Achievement                    |                                | Merit                         |                          | Excellence                                |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
|---|--|-------------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|--------------------------|---|---------------------------------------|---|----|----|--|---|---|---|----|----|---|----|----|---|--|---|--|---|--|
| <p>FOUR</p> <p>(a)(i)</p> <p>(ii)</p> <p>(b)</p> <p>(c)</p> | <p>Genotype individual 5 = tt</p> <p>If a dominant allele was present, then individual 5 would be a tongue roller. So therefore they must have only both recessive alleles present.</p> <p>Individual 6 is a tongue roller, and so must have at least one dominant allele present for tongue rolling to be expressed. Both of 6's children are a non-tongue rollers, which means they must have both recessive alleles and be tt. Because they get one allele from each parent, and individual 5 can pass on only a recessive allele, this means that 6 must have passed on the other recessive allele, and so therefore 6 must have one recessive allele. Therefore, because they must have a dominant allele so they can tongue roll and must have a recessive allele to pass on, they must have genotype Tt.</p> <p>Individuals 3 and 4 cannot be tt, as they are both tongue rollers. For them both to be tongue rollers, each of them must have at least one dominant allele, so this precludes tt as a possible genotype. It is not possible for individuals 3 and 4 to be TT, as one of their offspring is a non-tongue roller. A non-tongue rolling child must have genotype tt, because if they have a dominant allele at all, they would be able to tongue roll. One of each allele must come from each parent, and so for the child (individual 8) to be tt, a recessive allele must have come from each parent. For this to occur, each parent must have a recessive allele. Because the parents are both tongue rollers, they must each have a dominant allele, and because they both must have a recessive allele to pass on, they can only be Tt.</p> <p>Relevant Punnett squares drawn which could be:</p> <ul style="list-style-type: none"> <li>• A cross showing the two heterozygous parents.</li> <li>• A cross showing individual 3 or 4 with genotype TT and therefore shows that they cannot be TT.</li> </ul> <table border="1" data-bbox="255 1168 416 1289"> <tr><td></td><td>T</td><td>t</td></tr> <tr><td>T</td><td>TT</td><td>Tt</td></tr> <tr><td>t</td><td>Tt</td><td>tt</td></tr> </table> <table border="1" data-bbox="472 1168 642 1289"> <tr><td></td><td>T</td><td>T</td></tr> <tr><td>T</td><td>TT</td><td>TT</td></tr> <tr><td>t</td><td>Tt</td><td>Tt</td></tr> </table> |                               |                                |                                | T                              | t                             | T                        | TT  | Tt                                    | t | Tt | tt |  | T | T | T | TT | TT | t | Tt | Tt | <ul style="list-style-type: none"> <li>• States Individual 5 is tt / homozygous recessive.</li> <li>• States individual 5 cannot have a dominant allele / can only be non-rolling if tt.</li> <li>• States individual 6 must have a dominant allele / is Tt as can roll tongue but child can't / recessive allele masked.</li> <li>• States one allele comes from each parent.</li> <li>• States individual 8 / child of 3 and 4 must have genotype tt.</li> <li>• Draws a correct Punnett square.</li> <li>• States how TT or tt are not possible in (c).</li> </ul> |  | <ul style="list-style-type: none"> <li>• Explains that an individual with the dominant characteristic must have a dominant allele present, and relates it to specific individuals.</li> <li>• Explains that an individual with the recessive characteristic must have two recessive alleles, and relates it to specific individuals (5, 8 or 10 / 11).</li> <li>• Draws a correct Punnett square that is relevant to the question (and therefore the individuals involved) and uses it to give a correct explanation of the phenotype of one individual.</li> </ul> |  | <ul style="list-style-type: none"> <li>• Elaborates that both individuals 3 and 4 must be heterozygous, because they are both tongue rollers, showing they must have a dominant allele, and that they must both have a recessive allele, because for individual 8 to be non-tongue rolling, each of the parents must have passed on the recessive allele.</li> </ul> <p>AND</p> <p>Uses punnetts or explanations to show why 3 and 4 can't be TT or tt.</p> |  |
|   | T  | t                             |                                |                                |                                |                               |                          |   |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
| T   | TT   | Tt                            |                                |                                |                                |                               |                          |   |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
| t   | Tt   | tt                            |                                |                                |                                |                               |                          |   |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
|   | T  | T                             |                                |                                |                                |                               |                          |   |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
| T   | TT   | TT                            |                                |                                |                                |                               |                          |   |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
| t   | Tt   | Tt                            |                                |                                |                                |                               |                          |   |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
|   | <b>Not Achieved</b>  |                               |                                | <b>Achievement</b>             |                                | <b>Achievement with Merit</b> |                          | <b>Achievement with Excellence</b>        |                                       |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |
| Q4  | N0 = no response or no relevant evidence   | N1 = 1 point from Achievement | N2 = 2 points from Achievement | A3 = 3 points from Achievement | A4 = 4 points from Achievement | M5 = 1 point from Merit       | M6 = 2 points from Merit | E7 = Excellence point with minor omission | E8 = Excellence point fully discussed |   |    |    |  |   |   |   |    |    |   |    |    |   |  |   |  |   |  |

**Cut Scores**

|                    | <b>Not Achieved</b> | <b>Achievement</b> | <b>Achievement with Merit</b> | <b>Achievement with Excellence</b> |
|--------------------|---------------------|--------------------|-------------------------------|------------------------------------|
| <b>Score range</b> | 0 – 10              | 11 – 17            | 18 – 24                       | 25 – 32                            |