Assessment Schedule – 2011

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

Evidence Statement

Question	Evidence	Achievement	Merit	Excellence
ONE (a)	A section of DNA within a chromosome that codes for a trait / phenotype is called a gene. The gene in this example is squash fruit colour. An allele is an alternative form of a gene. In this case white or yellow fruit. Genes can differ slightly in their sequence of bases; these are called alleles.	• Defines or makes distinction between the terms gene AND allele.	• Explains relationship between gene and allele using examples, eg fruit colour = gene; white and yellow = alleles.	• Links explanation of the relationship between DNA, genes and alleles to an explanation of how alleles combine to produce genotype – evidence for this can come from anywhere in the question.
(b)	Two different alleles for squash colour are possible; white (F), which is dominant and yellow (f), which is recessive. Alleles come in pairs; for each gene there will be two alleles in each plant, one from each parent. The genotype is the combination of these alleles. There are three possible genotypes: • FF homozygous dominant • Ff heterozygous • ff homozygous recessive. A phenotype is the physical appearance of the genotype. These three genotypes give two possible phenotypes. Because both FF and Ff contain the dominant allele, this will mask any recessive allele and appear as white. For ff there are two recessive alleles (no dominant to mask), so these plants will have yellow fruit.	• Defines genotype as combination of alleles. • Defines phenotype as the trait that results from genotype / physical appearance. • Gives actual examples of genotypes as FF, Ff, ff. AND phenotypes as white and yellow. • Recognises heterozygote / Ff as dominant (phenotype) as has a dominant allele (or converse).	• Explains why a genotype has a particular phenotype (in terms of dominant and recessive alleles).	• Explains how three possible genotypes can only result in the two possible phenotypes of white and yellow fruit due to the interaction between dominant and recessive alleles, eg the recessive allele is masked by the dominant allele / only expressed if no dominant allele present.

	Not achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q1	NØ = no evidence or no relevant evidence	N1 = 1 partial point, eg one definition	N2 = 1 point from Achievement	A3 = 2 points	A4 = 3 points	M5 = 1 point	M6 = 2 points	E7 = 1 point	E8 = 2 points

<table>
<tr><th>Question</th><th>Evidence</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr><td>TWO
(a)</td><td>Dominant means the trait will be expressed, even if only one allele is present in a pair (heterozygous).
Recessive means the trait will be expressed only if two alleles are present (homozygous). It will be masked in the presence of one dominant allele (heterozygous).
Albinism is a recessive trait. This can be established using Generation III and Generation IV. In Generation III, two normal individuals have three normal offspring and one albino offspring.
The only way this is possible is for Generation III to both be Nn. When two n alleles come together, a homozygous recessive nn (albino) offspring forms.
If normal was recessive, Gen III individuals would be nn. There is no way of forming an individual with N in its genotype.
<table>
<tr><td></td><td>N</td><td>n</td></tr>
<tr><td>N</td><td>NN</td><td>Nn</td></tr>
<tr><td>n</td><td>Nn</td><td>nn</td></tr>
</table>
</td><td>• Defines the terms dominant and recessive.
• States the genotype of an albino must be nn / homozygous recessive
OR
• States the genotypes of Normal offspring could be NN or Nn.
• States that the offspring in Gen IV cannot be determined as they have no offspring.</td><td>• Completes a Punnett square Nn × Nn (gen 3–4).
AND
Explains that albinism is recessive because 2 normal parents produced an albino offspring.</td><td>• Discusses why albinism must be recessive with reference to generation III to IV (if was dominant the parents would be nn and could not produce dominant phenotype offspring).</td></tr>
<tr><td>(b)</td><td>All three Normal fur offspring are either Nn or NN.
Because their parents must have both been Nn to produce albino offspring, there is a 25% chance they are NN and a 50% chance they are Nn.
Their genotype cannot be established until they produce offspring.</td><td>• Gives a correct Punnett square from any generation (Nn x nn or Nn × Nn) NOT NN × Nn, NN × nn.</td><td>• Explains why normal offspring in Generation IV could be either NN or Nn.</td><td>• Explains that genotypes of normal offspring in Generation IV cannot be established as both NN and Nn are possible from Nn parents as in the punnet, OR explains reproduction with nn mate (test cross).</td></tr>
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	Not achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q2	NØ = no evidence or no relevant evidence	N1 = 1 partial point, eg one definition	N2 = 1 point from Achievement	A3 = 2 points	A4 = 3 points	M5 = 1 point	M6 = 2 points	E7 = 1 point	E8 = 2 points

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<tr>
<td>THREE
(a)</td>
<td>Women are XX, so when they create eggs with half the number of chromosomes, both eggs will have an X chromosome.
A male is XY so when they create sperm, half will have the X chromosome and half will have the Y chromosome
When the gametes come together (egg is fertilised), there is a 50% probability they will have a baby girl.
<table>
<tr><td></td><td></td><td>female
X</td><td>X</td></tr>
<tr><td>male</td><td>X</td><td>XX</td><td>XX</td></tr>
<tr><td></td><td>Y</td><td>XY</td><td>XY</td></tr>
</table>
The sex of the baby is determined by whether it is an X or a Y (sperm) that fertilises the egg. If it is X it will be female; if it is Y it will be male.
The fact that they already have one girl and one boy has no effect on what the next baby will be. Fertilisation is random at each event, and previous fertilisations have no effect.</td>
<td>• Correctly states probability of next child being a girl as 50%.
OR
States the sex of previous children have no relevance / no effect on future offspring.
• Uses labelled Punnett square to show how male and female babies are produced / female as XX with only X gamete and male as XY with X and Y gametes.</td>
<td>• Explains that it is the sperm / male that dictates the sex of the baby due to X and Y (chromosomes)
• Explains previous children have no relevance, as each new fertilisation is a new and separate event and outcome remains 50%.</td>
<td>• Explains that it is the sperm / male that dictates the sex of the baby by giving a male if Y sperm / gamete and female if X sperm / gamete.
AND
Explains there is no relevance of parents already having one boy and one girl on chance of having a baby girl due to each fertilisation being a separate event.</td>
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<tr>
<td>(b)</td>
<td>The parent / teacher became deaf because of loud noises related to teaching. Deafness was caused by ‘environment’, not genetics. (The question makes no reference to him having inherited deafness, nor was he born with it).
Only genetic characteristics can be inherited, not those acquired as a result of environment.
It is unlikely any of his children will be born deaf, as it appears the deafness was caused by environment, not genetics. However, we cannot determine whether they will be deaf at any stage in their life, as deafness can be work-related and it depends on the job they have later in life.
Genetics determines the characteristics you will be born with, but environment then affects these characteristics once you are born.</td>
<td>• States this type of deafness is caused by environment / loud noise, not genetics.
• States only genetic traits / information in gametes can be passed on.</td>
<td>• Explains unlikely that children will be deaf or go deaf due to noise as parent’s deafness was unlikely to affect gametes / reproductive cells produced / would only affect ear / somatic cells and will not be passed on.
• Explains that child unlikely to go deaf with noise UNLESS they have inherited a genetic weakness / predisposition AND is exposed to noise later.</td>
<td>• Discusses how characteristics are inherited and the effect of the environment on inherited characteristics such as deafness.</td>
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	Not achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q3	NØ = no evidence or no relevant evidence	N1 = 1 partial point, eg female XX	N2 = 1 point from Achievement	A3 = 2 points	A4 = 3 points	M5 = 1 point	M6 = 2 points	E7 = 1 point	E8 = 2 points

Question	Evidence	Achievement	Merit	Excellence
FOUR (a)	Genetic variation: variety within a population, eg different alleles possible for each gene. The advantage of variation to a population is that it may see some individuals survive if environment changes, eg drought, insecticides, disease. Because of variation, not all individuals will be wiped out. Those with favourable alleles / traits / phenotypes will survive and be able to pass on genetic material to offspring.	• Defines the term genetic variation. • States an advantage of variation (Advantage must clearly link to variation).	• Explains that differences in traits / characteristics / phenotypes may be of benefit if the environment changes. • Explains that only mutations in the gametes will lead to inheritable variation.	• Explains how a change in the DNA sequence can lead to a change in phenotype and increases variation. • Explains how mutations may be passed on if they are gametic (in gametes) not somatic (body cells).
(b)	A mutation is a change in genetic material / DNA / genes of an organism. When a mutation occurs, the base sequence of the gene changes; this results in completely new alleles. If mutations occur in the gametes, these new alleles have the possibility of being passed on to offspring. If mutation occurs in body cells, only the one individual will show variation – will not be passed on. Mutations do not always result in variation, but when they do, the variation is often in the form of entirely new alleles.	• Defines the term mutation. • States how mutations cause variation / new alleles.	• Explains how mutations contribute to variation within a population by referring to formation of new traits / proteins / phenotypes.	• Explains that mutations are more likely to be passed on if beneficial (natural selection).

	Not achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q4	NØ = no evidence or no relevant evidence	N1 = 1 partial point, eg one definition	N2 = 1 point from Achievement	A3 = 2 points	A4 = 3 points	M5 = 1 point	M6 = 2 points	E7 = 1 point	E8 = 2 points

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 10	11 – 18	19 – 24	25 – 32