



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

**Level 2, 2003**

**Biology: Describe concepts and processes that relate to genetic variation and change (90459)**

**National Statistics**

**Assessment Report**

**Assessment Schedule**

## Biology: Describe concepts and processes that relate to genetic variation and change (90459)

### National Statistics

Number of Results	Percentage achieved			
	Not Achieved	Achieved	Merit	Excellence
10,327	29.9%	54.3%	9.8%	6.0%

### Assessment Report

Every candidate for a National Certificate of Educational Achievement examination paper is expected to:

- read the question and do what the question asks
- allow adequate time to complete answers
- be accurate: check and/or proofread
- use appropriate technical terms
- bring the correct equipment
- write and/or draw clearly
- use pen if work is to be eligible for reconsideration.

### General Comments

Candidates were asked to describe concepts and processes that relate to genetic variation and change. Thus an ability to communicate their knowledge on the processes of meiosis, sexual reproduction, fertilisation, the concepts of mutation, natural selection, founder effect, and gene pool change, was examined.

Candidates able to complete Punnett squares to show a dihybrid cross and predict proportions of likely genotypes and their associated phenotypes, generally gained Achievement.

The reference to *genetic variation and change*, and understanding of the importance of this concept, are central to achievement in this standard. Candidates that clearly understand that variation is inherited, that it is provided by sexual reproduction and mutation, and that it is acted upon by selection pressures to provide change to a population over time, are able to work within the achievement criteria.

The standard states: “*This standard involves the description of concepts and processes that relate to genetic variation and change.*”

Candidates should regard all change to populations over time, in this light. The ability to complete dihybrid Punnett squares, an understanding of the mechanisms of meiosis and fertilisation at a cellular and sub cellular level, and the concepts of change to populations over time, are necessary for success in this standard. The use of correct terminology and spelling, as outlined in explanatory notes 3 and 4 of the standard, is also required.

Achievement in this paper demonstrates a candidate’s ability to describe the concepts of mutation, natural selection or founder effect, the process of fertilisation and meiosis, and the effects of the introduction of new organisms into a gene pool.

Candidates who achieved at the Merit level, were able to explain these concepts and processes in terms of the effects they have on individuals within a population, or more commonly, on the gene pool, or traits of individuals over time. These candidates demonstrated the ability to link ideas, use examples, and use correctly named terms or diagrams to explain processes.

At Excellence level, candidates were able to *discuss* by using specific, named examples in their response (eg distinct characteristics of Arapawa sheep, and named selection pressures), and to display correct spelling and usage of key terms. The ability to *justify and relate* concepts to *genetic variation and change* saw candidates gain Achievement with Excellence.

The majority of candidates who attempted a good proportion of the paper gained Achievement. Not Achieved grades usually went to candidates who did not complete a minimum amount of questions.

Clear definition of, and differentiation between, the terms allele, gene, genotype, mutation, and trait, enhanced candidates' ability to communicate knowledge. Candidates who linked the nature of change to allele frequency as a result of selection pressure, clarified the term 'dominance' as a gene expression concept, and not simply as a term used to describe the frequency, or prevalence, of that allele in the gene pool.

## Assessment Schedule

### Biology: Describe concepts and processes that relate to genetic variation and change (90459)

#### Evidence Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	Describe biological concepts and processes that relate to genetic variation and change.	Explain biological concepts and processes that relate to genetic variation and change.	Discuss biological concepts and processes that relate to genetic variation and change.
Judgement	Provides evidence of four description level answers in relation to genetic variation or change, ie 4 Achieved grades	Provides evidence of three explanation level answers in relation to genetic variation and change, ie 3 A + 3 M 4 A + 2 E	Provides evidence of one discussion level answer in relation to genetic variation and change, ie 3 A grades + 2 M + 1 E

Question	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence																									
1(a)	<p>Punnett square correctly identifies gametes and offspring. Squares show understanding of the joining of gametes.</p> <table border="1"> <tr> <td></td> <td>NB</td> <td>Nb</td> <td>nB</td> <td>nb</td> </tr> <tr> <td>NB</td> <td>NNBB</td> <td>NNBb</td> <td>NnBB</td> <td>NnBb</td> </tr> </table>		NB	Nb	nB	nb	NB	NNBB	NNBb	NnBB	NnBb	Nb	NNBb	NNbb	NnBb	Nnbb	nB	NnBB	NnBb	nnBB	nnBb	nb	NnBb	Nnbb	nnBb	nnbb		
	NB	Nb	nB	nb																								
NB	NNBB	NNBb	NnBB	NnBb																								
Nb	NNBb	NNbb	NnBb	Nnbb																								
nB	NnBB	NnBb	nnBB	nnBb																								
nb	NnBb	Nnbb	nnBb	nnbb																								
1(b)	<p>Table shows link between <b>TWO</b> of: genotype, phenotype ratio, and phenotype.</p> <p>Fraction / percentages / ratios accepted.</p> <p><b>BBNN</b>, 1, thick wool triplets  <b>BbNN</b>, 2, thick wool twins  <b>bbNN</b>, 1, thick wool single  <b>BBNn</b>, 2, mixed wool triplets  <b>BbNn</b>, 4, mixed wool twins  <b>bbNn</b>, 2, mixed wool single  <b>BBnn</b>, 1, normal wool triplets  <b>Bbnn</b>, 2, normal wool twins  <b>bbnn</b>, 1, normal wool single</p>	<p>Table shows link between genotype : phenotype ratio : phenotype.</p>																										
1(c)	<p>Description relating to sources of variation <b>or</b> mutation, eg: change to genetic material / only way to get new alleles <b>or</b> other sources mix / use existing alleles / acquired variation is not inherited.</p>	<p>Explanation relating to sources of variation <b>and</b> mutation eg: mutation is the only way to get new alleles / change genetic material : other sources mix / use existing alleles / acquired variation is not inherited.</p>																										

Question	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2	<p>Descriptions relating to development of distinct characteristics, eg:</p> <p>founder effect / initial variation less / small gene pool / traits from a small number of original sheep, <b>or</b> natural selection / selection pressures.</p>	<p>Explanations relating to development of distinct characteristics, eg:</p> <p>founder effect / initial variation less / small gene pool / traits from a small number of original sheep, <b>and</b> natural selection / selection pressures.</p>	<p>Discussion relating to development of distinct characteristics with a specific example or appropriate link, eg:</p> <p>links made between founder effect : small initial gene pool / population : less variation <b>and</b> links made between natural selection : environment / selection pressures : characteristics to survive / breed : pass on genes.</p>
3(a) (i)	<p>Description of how fertilisation produces variation, eg:</p> <p>genetic material / chromosomes : from both parents brought together / brings new combinations of alleles together.</p>		
3(a) (ii)	<p>Description relating to recombination <b>or</b> independent assortment, eg:</p> <p>recombination crossover / piece of homologous pairs cross, break, reform / this produces new combinations of alleles <b>or</b> independent assortment (during meiosis) chromosomes are randomly sorted / this process rearranges combinations of alleles.</p>	<p>Explanation <b>links</b> recombination <b>and</b> independent assortment to produce variation eg:</p> <p>recombination pieces of homologous pairs cross / break / reform : produces variability through new allele combinations <b>and</b> independent assortment (during meiosis) chromosomes are randomly sorted : rearranges combinations of alleles.</p>	<p>Discussion of <b>how</b> recombination <b>and</b> independent assortment produce variation, eg:</p> <p>As the two homologous chromosomes meet during meiosis, their adjacent chromatids cross over, so that the alleles from one chromosome swap places with the alleles from the other at the same locus. This causes unexpected allele combinations to be formed, ie combinations not found in the gamete producing cell or in the parents of this individual. This causes variation in the offspring, as each has a unique genetic makeup with different combinations of alleles for each gene.</p> <p>During meiosis the homologous chromosomes line up, paired. The way they line up is random, with equal chance of one homologue going to either daughter cell. This causes variation, because the gametes produced will have different mixes of the alleles on chromatids from the original 2 parents of the gamete producing cell. (Note: could use diagram.)</p>

Question	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(b)	Description relating to genetic effect of immigration, eg:  brings new alleles into the population / gene pool.		
3(c)	Description relating to benefits of introducing semen, eg:  adds variation / reduces genetic disease.	<p>Explanation relating to benefits of introducing semen, eg:</p> <p>adds variation / new alleles :</p> <p>links to benefits, eg variation in population where the environment may change / variation such that a disease could wipe out a whole group of genetically similar individuals / selection pressures (natural selection) can act</p> <p><b>or</b></p> <p>links to disadvantages, eg</p> <p>reduced variation increases chance of (recessive) genetic diseases / small gene pools increase chances of homozygosity.</p>	

### Judgement Statement

Judgement statements (formerly referred to as sufficiency statements) help students understand how their overall results for each standard were arrived at.

	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	<i>Describe biological concepts and processes that relate to genetic variation and change</i>	<i>Explain biological concepts and processes that relate to genetic variation and change</i>	<i>Discuss biological concepts and processes that relate to genetic variation and change</i>
Judgement	Minimum 4 × A	Achievement <b>plus</b> minimum 3 × M	Merit <b>plus</b> minimum 1 × E