L1 GENETIC VARIATION
CHEAT SHEET

STUDY TIME

ABOUT THE STANDARD

- Genetics is another meaty Level 1 Science standard, with lots of definitions to remember and lots of concepts to explain.
- Just like the other standards though, you can break down the standard into three easy parts:
  - **DNA and how it works:** DNA, genes, alleles, chromosomes, genotypes and phenotypes.
  - **Inheritance and variation:** inheritance of alleles/chromosomes, mutations, meiosis, fertilisation; patterns of inheritance, including punnett squares and pedigree charts.
  - **Reproduction, survival and natural selection:** sexual vs. asexual reproduction, effect on phenotype on survival, and therefore passing down genes/alleles to the next generation, and the importance of variation on survival.
- Use our walkthrough guides to make sure you know the content, and if you take on the strategies we're about to discuss, you'll be able to come out on top.

EXAM STRATEGIES

- Succeeding in genetics, and in Biology in general, is based on understanding the definitions of key phrases.
  - Fortunately, NZQA have written a list of words you MUST know:
  - You must be familiar with the following words and phrases:
  - Gene, allele, mutation, genotype, phenotype, gamete, zygote, dominant, recessive, homozygous, heterozygous, pure breeding, Punnett square, and pedigree chart.
- Not only that, but there's usually a question based around the relationship between DNA, genes, alleles, chromosomes, genotype and phenotype. Luckily, we're here to help you out:
  - Remember that DNA is the (molecule) that carries the genetic code/ information and can be passed down to the next generation.
  - Along the DNA, base sequences provide the code for building different proteins, which then determine particular features
  - A gene is a section of DNA that codes for a particular trait – e.g. fur colour
  - Alleles are different forms a gene can take, or you can think about it as the specific base sequence, e.g. W could be the allele for white fur and w could be the allele for brown fur
  - Genotype is the allele combination present for a particular gene. e.g. Ww for the fur colour gene, and the phenotype is the physical appearance of a trait e.g. white or brown fur.
  - If you know all of these definitions and can link them together, you'll be right on track for success!
- This standard is also all about variation, which is all about the differences individuals can have in their genetic makeup.
- One of the main ways of gaining genetic variation is mutation. A mutation is a change in the DNA base sequence, which means a different protein is made, and so therefore a different phenotype is produced.
  - Mutations are important because it results in the production of a new allele.

- Another main source of variation is through Meiosis. Remember that Meiosis makes gametes (or sex cells), whereas Mitosis makes non-sex (somatic) cells.
  - Each individual has 23 pairs of chromosomes, which means we have two copies of a gene, and therefore two alleles. For example, Ww where W is one allele and w is the other allele.
  - Each gamete made in meiosis has only has one set of our 23 of chromosomes, so only has one copy of the gene.
  - This means that we get 1 set of chromosomes (and therefore one allele of a gene) from Mum and 1 set (and therefore one allele of a gene) from Dad.
  - As the chromosomes are shuffled randomly during meiosis every gamete is different, and so each individual (even from the same 2 parents) is a unique combination of its parent's alleles. This random assortment of chromosomes means that meiosis increases variation.
- Another source of variation is Fertilisation.
  - Sexual reproduction involves combining DNA from two parents using gametes.. Gametes have only one set of chromosomes, and so these can be combined with another parent to make a unique individual. Random male and female gametes join, producing a unique zygote (or fertilized egg).
  - So that means that the randomness of fertilisation produces variation between individuals.
- As you will be painfully aware of by now, this standard involves interpreting punnett squares and pedigree charts.
  - Punnett squares predict the like offspring genotypes and the expected phenotypes, based on the allele carried by each gamete of the parents, whereas pedigree charts give the observed (actual) phenotypes in a real life scenario.
  - For merit or excellence, remember that the genotype/phenotype ratio in Punnett Squares is 'expected' only, is just a probability and so needs a large sample size to be seen. This means it may not be observed in smaller samples.
  - For example, if your expected phenotype ratio is 3 white fur: 1 brown fur, and you only have 3 offspring, your actual phenotype ratio might be 3 brown fur!
- When interpreting pedigree charts, look at the offspring and draw a punnett square to help you figure out the genotype for the parents.
  - For example, if you had two dominant phenotype parents, but then in your offspring, you had some with a recessive phenotype, then you know that both of your parents MUST be heterozygous. You can figure this out this using a punnett square.
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- Another common type of question is inheritable vs non-inheritable variation. Or, in less technical terms: when are changes in phenotypes passed down to the offspring? To tackle this kind of question, remember the following:

- Inheritable variation can be passed onto offspring and involves a change or mutation in the DNA.
- In contrast, non-inheritable variation may be due to the environment, or only occurs in body or non-sex cells, and so affects only that organism, not its offspring e.g. a scar
- Also remember that based on what we've just said, a phenotype is therefore determined by both genetics and environment! Just because someone has a gene or allele for a particular trait, it doesn't necessarily mean that the phenotype will express, as the environment may change it again.

- Our final tip is around asexual vs sexual reproduction. Asexual reproduction is rapid and energy efficient, and can be done without a partner, but provides no genetic variation. Sexual reproduction is slow and energy intensive, and needs a partner, but does result in genetic variation (due to meiosis and fertilisation discussed earlier in the video!).
  - Also remember that variation is important because if environmental conditions change, some organisms may not be suited to the new conditions and may not survive, but other organisms, which are different, may be suited to the new conditions and can survive.
  - If there was not variation, all organisms would be the same, so if a disease came, for example, then all of the population would be wiped out.

OVERALL

- We've covered some important strategies and things to remember, but we haven't covered everything.
- As we said at the start of this video, we really recommend going through the last 3-4 years of exam papers, and also using the StudyTime Walkthrough Guide and Checklist to really check and consolidate your knowledge and feel 100% prepared!