L2 GENE EXPRESSION
CHEAT SHEET

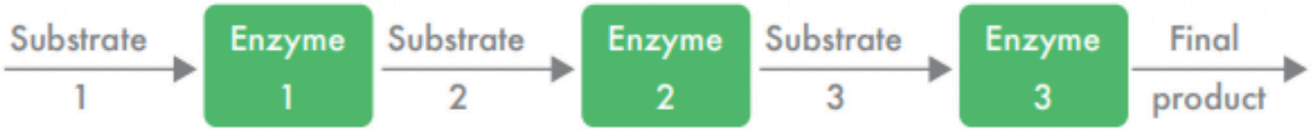
STUDY TIME

ABOUT THE STANDARD

- A lot of students try to study this topic as a bunch of unrelated concepts, but it's really just one big process.
  - If you're panicking about how to cram for the whole topic, try drawing out a flow chart of all the steps between DNA and a fully formed protein.
  - Every time you encounter a new concept, try to work out where it slots into the content you've already covered.
- Within this one long process the two main bits to know in detail are transcription and translation. You need to be able to explain:
  - Where each process happens (e.g., in the nucleus)
  - What main steps each process involves
  - The role of enzymes in these steps

KEY CONTENT

- A part of this standard that often seems to trip people up is metabolic pathways.



In fancy terms, these are 'a set of enzyme-catalysed reactions where the product from one reaction acts as the substrate for the next'.

  - In less fancy terms, this is when a substance is gradually turned into an end product by a whole chain of enzymes.
  - If any part of this chain breaks, the end product won't be able to be made, so many different mutations can lead to the same end result.
  - Sometimes this broken chain can lead to a buildup of a toxic product (like for example if enzyme 2 broke in the chain above, substrate 2 would build up, which could potentially be harmful).
  - If two parents have the same metabolic disorder but have different mutations, they could have offspring who are completely healthy, because overall the offspring would have functional alleles for every gene in the pathway.
- You can also be asked to compare and contrast mRNA and DNA.
  - Key similarities between the two are that they are both nucleic acids, they both have similar base pairing rules, and they both are made up of nucleotides.
  - The key differences are that mRNA is a much shorter molecule (it codes for one gene, while DNA codes for the entire set of genes), RNA has a U base instead of T, and RNA is single stranded.
  - The reason for having both is that DNA needs to stay safe in the nucleus as the genetic code needs to be passed on identically to every cell, and also that many copies of the same gene can exist in mRNA at

the same time while only one copy is on the DNA (so lots of protein can be produced).

- Another common question is to ask you why some mutations are more serious than others. Here, you want to be familiar with the effects of substitution mutations versus insertion or deletion mutations – in particular, the fact that a frameshift mutation will screw up the whole protein while a substitution mutation will only change a single amino acid.
    - Included in this is the idea of redundancy in the genetic code. Substitution mutations sometimes have no effect at all, because there are lots of double ups when it comes to what amino acid each codon codes for.
    - A protein's shape is basically responsible for its function, so if it has the wrong amino acids it will have the wrong shape and not be able to function.
- Questions can also focus on the interactions of genotype and environment to cause the phenotype.
    - The idea here is that although your genes code for all the potential proteins your body can make, they are not necessarily all expressed at any given time.
    - For example, your skin might have the ability to tan, but this trait won't be expressed unless you spend time in the sun.
    - Often the question will involve genetically identical organisms (such as cuttings from the same plant) which are placed under different conditions and develop different traits. They need to be genetically identical so that scientists can be sure that any differences between them are entirely due to the environment.
    - In general, to express a particular trait, an organism needs to have the gene for that trait but also needs the right environmental conditions (e.g., temperature, climate, nutrients)

OVERALL ADVICE

- Everything comes back to the idea that one gene codes for one protein.
- Make sure you practice reading the tables for what amino acid each codon codes for.
- You also need to be able to draw and/or label a diagram of a section of DNA, including nucleotides, base pairs, sugars, phosphates and triplets.

vFor metabolic pathway questions, you should make use of diagrams to show how different genes can be mutated and cause a broken pathway.