Protein Synthesis

Transcription and Translation

Structure of Proteins

- Proteins are hundreds of amino acids strung together in several polypeptide chains, and then folded up into a 3D shape.
- Each protein is put together starting from 20 amino acids.
Protein Synthesis Overview

- **Problem:** DNA resides in the nucleus, but protein is made in the cytoplasm.
- **Solution:** DNA has to stay in the nucleus, so instead of having the DNA leave, a single-stranded copy is made (RNA) which leaves the nucleus.
- **The process of copying DNA into RNA is called transcription.**

- **Problem:** How is one language (nucleotides) translated into the other (amino acids)?
- **Solution:** Proteins are assembled from amino acids on ribosomes using RNA instructions.
- **The process of assembling proteins from RNA instructions is called translation.**

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**Transcription – DNA making RNA**

- **DNA**
  - Double-stranded sugar-phosphate backbone
  - Bases: cytosine, guanine, adenine and thymine
- **RNA**
  - Made from DNA
  - Single-stranded sugar-phosphate backbone
  - Bases: cytosine, guanine, adenine and uracil
Transcription – DNA making RNA
- Three types of RNA transcribed
  - mRNA (messenger RNA)
  - rRNA (ribosomal RNA)
  - tRNA (transfer RNA)
- Making mRNA
  - Base pairing is used to copy DNA into RNA
- Processing RNA
  - mRNA is “edited”, cutting out introns and keeping exons before translation can begin.

DNA Codes For Amino Acids in Proteins
- There are four DNA bases (A, T, C, G), but there are 20 amino acids incorporated into proteins.
- Sydney Brenner suggested that DNA used a triplet code. Three DNA bases together specified a single amino acid.
- Each coding triplet of mRNA bases is called a codon.

From Bases to Amino Acids
- The question was posed: “Which three bases code for which amino acid?”
- It took scientists years to figure this out but when they did, the result was the genetic code.
  - The code is redundant
  - There are instruction codons for “start” and “stop”
  - The code is universal
Translation

- Necessary molecules:
  - mRNA – carries instructions in the codons
  - Ribosomes – location of protein synthesis
  - Amino Acids
  - tRNA – links to free amino acids and transfers it to the ribosome where it links to the appropriate mRNA codon.

Steps of Translation

- mRNA binds to a ribosome and the first tRNA carrying the code for Methionine (met) attaches to the mRNA at the “start” codon (AUG).
- The next tRNA attaches to the mRNA.
- A bond forms between the two amino acids, beginning a polypeptide chain.
- The tRNA carrying the first amino acid (met) is kicked off the ribosome.
- The polypeptide chain is elongated until the “stop” codon is encountered on the mRNA.

What is a gene?

- A gene is a segment of DNA that brings about the transcription of a segment of RNA.

How does DNA relate to genotype and phenotype?

- Genotype – Contains the genetic information (DNA) for traits.
- Phenotype – DNA codes for the making of proteins and the expression of those proteins give us our traits.