Cognition Games

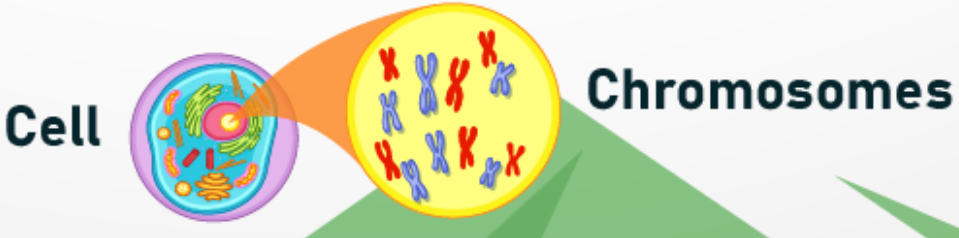
Learning Notes

Introduction

Have you ever wondered why you look similar to your family or look different to your best friend in Science class? The reason for this is called Heredity. This is the passing of traits from one generation to the next and it is DNA that carries this trait information. Let us delve deeper into the human cell, to understand chromosomes, which contain your DNA!

Chromosomes

Chromosomes are in the nucleus of all of your cells. These are long, thread-like molecules that contain DNA. Humans have 23 pairs of chromosomes (46 in total). For each chromosome pair, 1 chromosome comes from your mother, and the other comes from your father. A deeper look into the chromosome reveals the structure of DNA.



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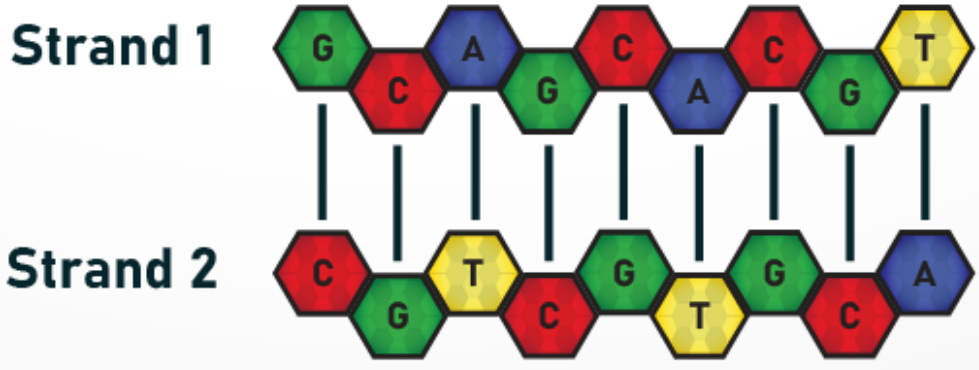
DNA

DNA consists of two strands (double-stranded), wrapped into what is known as a “double-helix” structure. The two strands are linked together by what are called DNA “bases”. There are four different bases: Adenine (A), Thymine (T), Guanine (G) and Cytosine (C). Each base can only link with one other type, Adenine pairs with Thymine and Cytosine pairs with Guanine. A long section of these DNA bases can create a protein. This “section” is called a “protein-coding gene” and accounts for about 1% of the human genetic code. The remaining 99%, are considered “non-coding” regions. It is the “protein-coding” genes that govern the way we look and susceptibility to different diseases.



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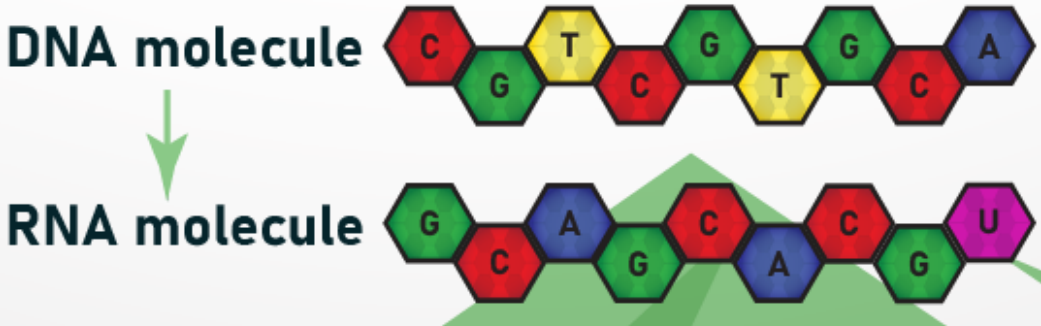
Cental Dogma

You may be wondering how DNA bases are used to create these different traits or characteristics? This can be explained by the Central Dogma theory. This states that genetic information in your DNA, is used to create RNA, which in turn is used to create protein. DNA is made into RNA during a process called transcription.

Transcription **Translation**

DNA → **RNA** → **Protein**

During transcription, the DNA unwinds forming a single-stranded DNA molecule. The DNA is "read" by an enzyme called RNA polymerase. Every time it reads a DNA base, the enzyme adds a complementary RNA base. Using the same base pair rules as discussed before, the enzyme adds A to T, C to G and G to C. The only difference in this process to DNA pairing, is that U (Uracil) pairs with A. This is because it is an RNA molecule forming, instead of a DNA molecule. Note that RNA is single-stranded.



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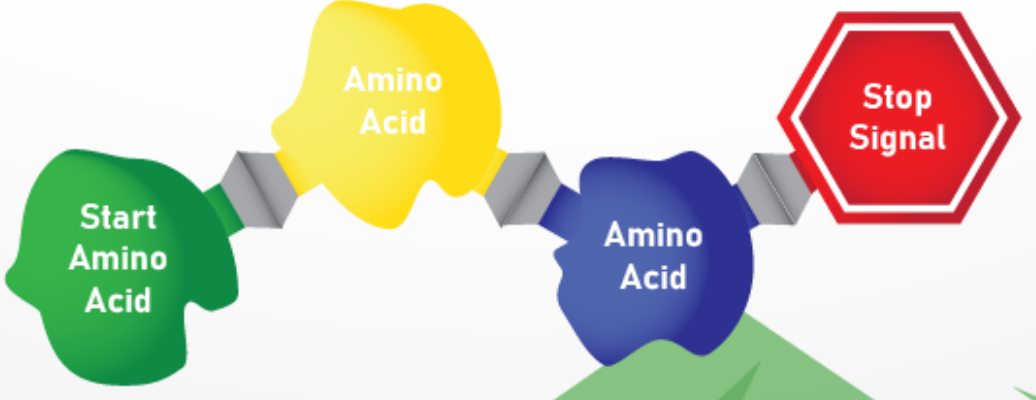
Translation

The RNA molecule created by transcription (also called messenger RNA) can be very long. During translation, the ribosome reads this RNA molecule, three bases at a time. The three letters the ribosome reads is also known as a "Triplet" or a "Codon". There is a "start codon" that tells a ribosome where to start translation. For every three-letter codon that is read after this, an amino acid gets added to a growing chain. These amino acids are the building blocks that create a protein. This chain ends when the ribosome reads the stop codon, which can come in 3 different forms: "UGA","UAA" & "UAG". The proteins that are made maintain our biological processes and cause us to have different traits and characteristics. Below is a simplified diagram of an amino acid chain, however, in reality, chains are generally 100's of amino acids in length!



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DNA and RNA

The standard genetic code is traditionally represented as an RNA codon table because it is mRNA that directs protein synthesis. However, with the rise of computational biology and genomics, most genes are now discovered at the DNA level. It is therefore important to understand a DNA codon table, such as that used in “Code On”. The main difference in biochemistry between RNA and DNA, is that Uracil (U) replaces Thymine (T):

DNA	→	RNA	→	Protein
DNA Codon		RNA Codon		Amino Acid
CTT	→	CUU	→	Leucine
ATA	→	AUA	→	Isoleucine
AAT	→	AAU	→	Asparagine

In “Code On”, these amino acids and the three DNA bases that create them, are represented as cards. It is now up to you to uncover these hidden triplets of DNA bases, and discover the vital information present in our genes!