The Secrets of DNA

I hear the abbreviation "DNA" being used every day on the radio, TV, and even by Charlie Sheen, but what really is DNA?

PRACTICAL SCIENCE WITH PHIL FREDA

DNA or deoxyribonucleic acid (I know, it's a mouth full), is an essential molecule found in all living things and in every living cell.

Think of it as the blueprint that has instructions on how to build a living thing, whether it is bacteria or an elephant!
A living thing's genome consists of all the DNA specific to that organism. In other words, all of the information (DNA) that makes up you, in total, is referred to as your genome.
Every cell in your body (except red blood cells) have the entire genome inside their respective nuclei.
In complex organisms such as ourselves, there are different kinds of cells with different roles. Even though the cells in your body contain the entire set of instructions to make you (from your brain to a strand of hair), they only express the cells necessary to them.

Liver cells only use the DNA instructions that pertain to liver function and not hair growth or bone structure. The rest of the genome is inactive and not expressed.

What is DNA made of?

DNA is made up of repeating subunits called nucleotides. Think of these nucleotides as individual chain links in a larger fence. The fence would be the DNA molecule in its entirety.
Each nucleotide is further broken down into three parts: a sugar, phosphates and a base.
In DNA, there are four different kinds of bases found: Adenine, Guanine, Cytosine, and Thymine.
These bases are integral to life and all of its processes.

I'm sure most of us have heard that DNA is a "double helix."
What this means is that in a standard DNA molecule there are two strands of repeating nucleotides that run parallel to each other. Think of each of these strands as the stringers (vertical parts) of a ladder.

This is where those bases come in. The four DNA bases are attracted to one another. Adenine is always attracted to Thymine and Cytosine is always attracted to Guanine. The pairing between these bases form the rungs (steps) of the ladder.

After the bases have paired, you now have a ladder shape.

Now for the last step. Use your imagination and envision the ladder in your head. Now imagine pinching the ladder at the top and the bottom and gently twist. This is what a DNA chromosome looks like.

The genetic code

How is this twisted ladder the blueprint for a human being? Well, it's a very complicated process, but here's how I understand it.

Remember the four bases; Adenine, Thymine, Guanine, and Cytosine? Good!

There are special proteins in every one of your cells that can read the rungs of the ladder. For simplicity, we will abbreviate the bases.

We will call Adenine **A**, Thymine **T**, Guanine **G** and Cytosine **C**.

When laid on its side and untwisted, the DNA ladder is a sequence of these bases.

For example, a very simplistic sequence may read: ATCTTCGGTATACCTTAGAGGTTC.
This may seem like gibberish, but it is actually a code.

When shopping, I'm sure you have noticed the bar codes on the goods you are buying. Those red scanning lasers that the cashier shoots at your bag of Doritos reads the sequence and thickness of the bars in the bar code and converts it to information.
In computers, all of your programs and files are actually written in a binary code of zeros and ones. DNA code is similar to these everyday man-made codes in that it contains information in its repeating sequences.

Transcription

As previously stated, special proteins called polymerases in your body have the ability to read sections of your DNA called genes.
Genes are usually instructions that encode for a specific protein.
There is a slight problem, however.

Proteins are made up of units called amino acids, not nucleotides. These polymerases have to convert this information from the DNA language to the amino acid language.

The first step of this conversion is called transcription.
RNA polymerase proteins bind to the gene and run along it while reading the sequence of A's, T's, G's, and C's.

RNA polymerase not only reads this sequence, but makes a duplicate copy of it in yet another language, called RNA. RNA is a close cousin to DNA and is also a long chain of nucleotides. After the DNA language has been converted to RNA, the new RNA molecule is released, and transcription is complete.

Translation

The new RNA strand, called messenger RNA, or mRNA for short, is snagged up by a very special enzymatic machine called a ribosome.
The ribosome's job is to read the mRNA like a book and translate it to protein. Every three nucleotides of RNA is called a codon, and each codon is a stamp for a certain amino acid. The ribosome reads the RNA one codon at a time and, for each codon, adds a new amino acid to a growing chain of protein.

When the ribosome is finished reading the entire mRNA molecule, it makes a new protein. These proteins are the workers of the cell and do every thinkable job, including breaking down food, repairing cellular damage and building new structures in the cell.

The big picture

Transcription and translation are happening at every moment in almost every cell in your body, and in case you were wondering, you have over 100 trillion cells!

DNA is the blueprint for life, and proteins are the units that make life possible. The genetic code may be just a bunch of molecules strung together, but it is much more than this—the genetic code is you! Think about it!

I understand that some of the topics discussed in this article may seem somewhat difficult to understand. I highly stress watching the videos embedded within the article.

As always, I look forward to your comments. Thank you!