

DNA Necklace

Tom Zinnen, Biotechnology Center, UW-Madison



DNA is a lot like an alphabet. How many letters are there in the English alphabet? Yeah: there about 26 letters in the English alphabet. How do you spell different words in English? You string different letters together in different orders to give different words with different meanings. You can you string letters into words, words into phrases, phrases into sentences, sentences in a paragraphs, paragraphs into pages, pages into chapters, chapters into books, and books into a book series.

And if you're JK Rowling can you sell it all for \$1 billion?

DNA is a lot like that: it's an alphabet made up of letters that you can string together into chains of information. But the DNA alphabet doesn't have 26 letters; it has only four letters. They are called by the first letters of their full names: A, T, G & C (for adenine, thymine, guanine and cytosine). We are going to represent those four different letters, or those four different bases, of DNA using 1.5 mL plastic tubes with caps and filling each tube with one of four colors of water: red, yellow, blue, or green.

Then we can string tubes full of the water in any order (that is, in any sequence) that we would like, and for as long as we would like. (Or, of course, until you run out of tubes.) How many tubes would be need to make a DNA string as long as all the DNA in a human cell? We would need a really long string of tubes to represent the amount of DNA in a human cell. It would have to be a string that is 3 billion tubes long.

When we make our DNA model, we can string the four colors (that is, the four letters) together in any order and to any length that we would like.

Can we take a long string of DNA tubes and make them into a circle? Can we take a circle of DNA tubes and break it once into a line? And can we take several lines of DNA and link them together into one really long line of DNA? Or can we take a really long line of DNA and break it into two or three or more pieces?

These are all things that DNA does also.

You'll also notice that the DNA string of tubes is a lot like a snake: there's a head and there's a tail. The head is the end with the empty tube without a cap on it; the tail is the end with the free cap dangling.

So if you would like to tell a friend of yours the order of the four colors in your DNA necklace, do you need to tell the friend which end you're starting with?

Are you giving the colors by starting with the empty tube at the end or are you starting with the colors at the end with the free cap?

This is a lot like looking at the word stop STOP compared to the word parts POTS. These are actually the same four letters in the same sequence, but you have to say whether you're reading from right to left or from left to right.

In English we read from left to right, but other languages, such as Arabic or Hebrew, read from right to left.

This metaphor of DNA being like an alphabet goes as far back to the 1950s. You can see that metaphor in the words that we use to describe the flow of information in DNA and from DNA to amino acids and proteins.

You may have heard the word “replication,” which means to make a copy of something. For example, scribes can make replicas of an original book by hand-writing the words on a new sheet of paper.

Then there's the word “transcription” which means to write from one alphabet into another alphabet. The most common example for us is to transcribe from the Greek alphabet into the Roman alphabet.

Then there's translation, which means to take a word in the Roman alphabet which is also the English alphabet, and translate the word's meaning without having to change the letters.

For those of us who read English, we can read Latin words because it's the same alphabet as an English even though we may not be able to understand the words. You have to translate the Latin word into an English word. But if you try to read ancient Greek, you can't even figure out what the words are because it's a different alphabet, and in part that's what Shakespeare meant when he said, "It's Greek to me."