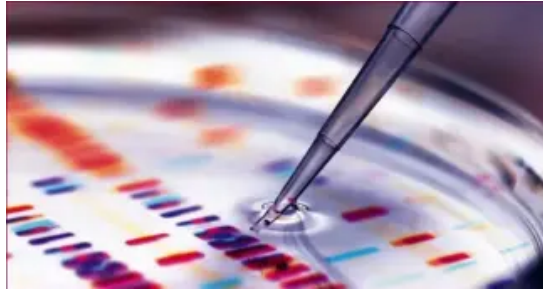


## IF GENES ONLY MAKE UP AROUND TWO PER CENT OF OUR DNA, WHAT MAKES UP THE OTHER 98 PER CENT?

BBC Science Focus · 22 Feb 2024 · 81

It was barely a generation ago – during the spring of 2003, in fact – when scientists at The Human Genome Project completed their work sequencing the human genome. But even for the world's leading geneticists, the 'Book of Life' is a heavy read. Researchers are still making sense of it.



It was a landmark moment, of course, not just in science, but in life on Earth – the first time an organism catalogued the very building blocks that it's made of. It sparked the genetic revolution that we're currently living through, but it also raised some serious questions. Questions like, 'Why is there so much of it?'

One of the strange and startling things about the completed human genome was how little of it seemed to be doing anything. There are around three billion nucleotide pairs in the human genome (the 'letters' in our DNA: A, C, G and T). Less than two per cent of those (around 20,000) represent protein-encoding genes that give the cells in our bodies their marching orders. So, what's the rest of it doing?

Some called it junk DNA. Genetic gibberish – a pile of leftovers from millions of years of evolution or an impossible word search where very little makes sense. And it seems that at least some of it is indeed non-functioning. But not all of it.

Scientists are beginning to shed light on this dark matter of the human genome. Far from a junk heap, it performs a crucial regulatory or modifying function for the protein-encoding genes. Some have likened these DNA sequences to volume-control buttons for how our genes are expressed. For example, enhancer sequences increase the transcription of genes from DNA to RNA. Silencers do the reverse.

Large swathes of the dark genome are also made up of long, repetitive sequences of DNA known as transposons. These too play a critical role in the way our genes are expressed, and they're linked to momentous evolutionary steps and our ability to adapt to our environments.

Also known as 'jumping genes', transposons can move from one section of a genome to another. This ability can trigger seismic genetic mutations and reversals. Scientists believe, for example, that transposons are linked to the development of opposable thumbs in humans and the loss of tails in our species and other great apes.

They may also be responsible for tumour development in some circumstances, as well as certain hereditary diseases. Haemophilia and Duchenne muscular dystrophy are two examples thought to arise from repetitive DNA sequences linked to transposons.

That's just one reason why the dark genome is now a hotbed of medical research. Scientists hope that in the next two decades, our growing understanding of these once-ignored chapters from the 'Book of Life' will lead to a new generation of therapies for treating genetic disorders.