The double helix

Our cells contain a set of operating instructions in the form of deoxyribonucleic acid, or DNA. DNA always has the same basic structure—two long strands that wind around each other to form a double helix, or spiral. DNA holds the coded instructions, called genes, that are needed to build and run cells. Importantly, it can also copy itself, making sure that instructions are passed on accurately when cells divide.

DNA's structure
The 46 chromosomes inside the nucleus of each human body cell contain an incredible six feet (2m) of DNA in total. Each long, thin DNA double helix is made up of building blocks called nucleotides. Each nucleotide consists of a sugar called deoxyribose, another component called a phosphate group, and one of four “letters” or bases. Millions of nucleotides link up to make each DNA molecule. The molecule looks like a twisted ladder with the bases acting as the ladder’s “rungs.”

DNA is made up of building blocks called nucleotides. Each nucleotide consists of deoxyribose, a phosphate group, and one of four bases called adenine (A), cytosine (C), guanine (G), and thymine (T). Millions of nucleotides link up to make each DNA molecule. The deoxyribose and phosphate groups form a “backbone” on the outside.

Chromosomes are found inside the cell’s nucleus. Each one is made up of a DNA double helix that is coiled up and then coiled again into a “supercoil”—similar to a telephone cord—which is held together by proteins.

The bases—A, C, G, and T—hold the strands together, like rungs on a ladder. Notice that the bases always form specific pairs—each can only pair up with the same partner. A always pairs up with T, and G always pairs up with C.
Making copies
DNA is the only molecule found in living things that can replicate, or make an exact copy of itself. This happens just before a cell divides through mitosis (see pages 12–13). It means that the two new cells that result from cell division receive duplicate sets of identical genes. The two strands of the DNA double helix separate, just like a zipper opening.

Matching up
Each unzipped piece of DNA acts as a template. Free, unattached nucleotides in the cell—containing one of the four bases A, C, G, or T—line up across from their partner bases on the template. A nucleotide containing A will line up with T on the template, and one containing C will line up with G. Bases attach to each template strand and a new “backbone” forms, and the twin strands start to twist. The unzipping and copying process continues along the length of DNA until two new, identical double DNA strands are produced.

Coded message
As you can see the bases in each DNA strand do not occur in a regular order. They form an alphabet of four letters that spell out coded instructions, just as the 26 letters of our alphabet spell out words. The words written in genetic code consist of three letters in a row, such as ATG or GCC, and are called codons. In total there are 64 different codon “words.” A sequence of codons makes up a gene, just as words make up a paragraph. And thousands of gene paragraphs make up the complete book of instructions. On the next page we will look at how the coded instructions contained in genes make a cell work.
To see more from *Genes and DNA* by Richard Walker, go to 576.5 Wal in the MRMS library