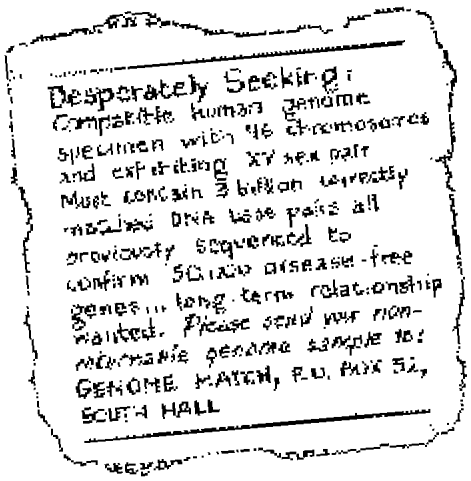
What Will the Future Bring?

Imagine this sign found on a bulletin board at a local school:



Does this seems like an odd way to seek out a mate? It might be, but it would be one way to find out a great deal about someone. Everyone's genome provides a blueprint of their biological potential. It contains "directions" for the color of their eyes, of their hair (and whether they will have it when they are older), their projected height, even their potential for cancer, heart disease, or whether they may develop Parkinson's or Alzheimer's disease.

The human genome is found in each and every one of the many trillion of cells that make up the body. (See illustration, page 27.) Contained within these cells is a special structure called the cell nucleus. Coiled inside each nucleus are the 46 chromosomes a person inherits from her parents (23 each from the sperm and the egg). The parents, in turn, inherited their genes from their parents, and on back down the line to the very first cells that evolved. In each of the chromosomes is a molecule known as deoxyribonucleic acid (DNA). Containing a specific genetic code, the DNA molecule appears as a long chain of four distinct building blocks, or nucleotides. These nucleotides are abbreviated to four simple letters, A for adenine, and T for thymine, C for cytosine, and G for guanine.

While the sequence of letters is random in 97 percent of the 3 billion base pairs that comprise the genome, the remaining 3 percent (about 1 million base pairs), contain the specific DNA nucleotide codes for making up a person. These letters form about 30,000 to 50,000 genes, each containing instructions for proteins, the major molecules that make up cells and tissues. The average-sized gene is 3,000 base pairs.

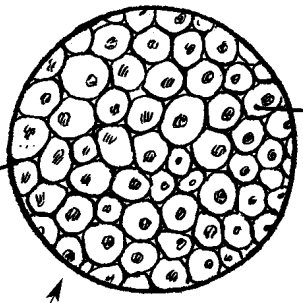
Initiated in the late 1980s, the Human Genome Project set out to identify the sequence of nucleotides (A, T, C, and G) in all the DNA that comprise a human being. Although people are more alike in their DNA than they are different—in fact, people are 99.9 percent alike—each person still contains a unique genetic code. In some instances, these coding differences are as simple as an alteration in one letter out of 1 million and have no impact on health. In others, these coding differences are the result of mutations that can cause genetic diseases such as cystic fibrosis or sickle cell anemia.

But big questions come with this genetic knowledge. What effect will mapping the genome have on people and society? Will this genetic information be used to discriminate against those with genetic predispositions? Will people decide to alter human traits, to pick and choose what they perceive as "normal" or "above average?" If prenatal screening reveals an embryo to have a predisposition to disease, what should the parents do? Who will govern how someone's personal genetic information is used?

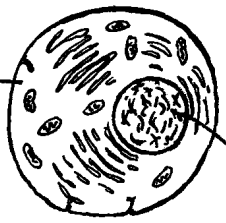
It is important to note that mapping the human genome is just the beginning. Knowing the sequence of the genome will help to identify genes, but scientists will then have to identify which genes are responsible for specific diseases. Even then, the diagnosis could be ambiguous; having a gene or genes does not always guarantee that someone will get a disease, just that the person might be predisposed to it.

The activities found in the following pages are designed to help students begin to understand the scientific principles and ethical, legal, and social issues behind the Human Genome Project.

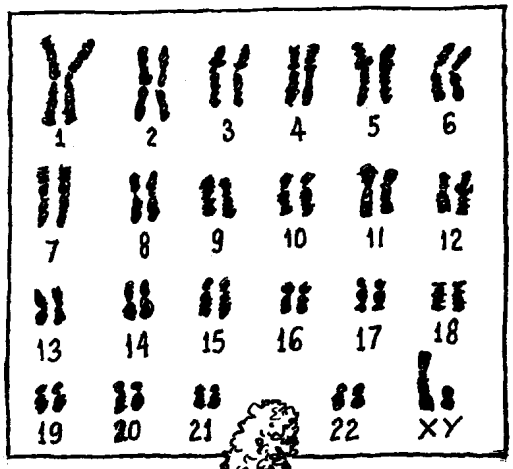
Contents **page**



All of you—your bones, muscles, nerves, skin, and blood—is made up of **cells**. There are more than 10 trillion cells in your body.

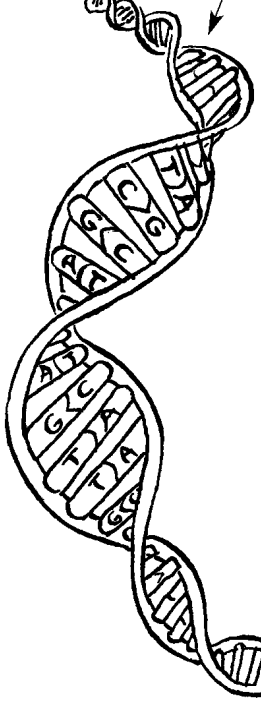


In the **nucleus** of almost every single cell are the complete instructions for making you. Those instructions are found in 23 pairs of **chromosomes**. This set of instructions is called your genome.

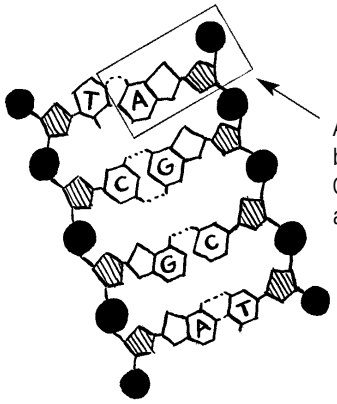


Each set of chromosomes—half of which come from your mother and half from your father—contains one tightly packed strand of **DNA**.

This DNA takes the form of a double helix that looks like a long, twisting ladder.



This ladder is made up of a series of letters—A, T, C, G—that represent the chemicals adenine, thymine, and cytosine, and guanine. One pair of letters is called a **base pair**; a base pair is formed by the binding of two nucleotides. (A always pairs with T, and C always pairs with G.) A series of nucleotides, then, forms a **gene** that codes for a protein. Your genes produce thousands of different **proteins**.



A nucleotide contains a base molecule (A, T, C, or G), a sugar molecule, and a phosphate molecule.

Each strand of DNA may contain several thousand genes. Some genes are thousands of bases long; others are millions of bases long.

The goal of the human genome project is to determine the complete sequence of the human genome—to put 3 billion As, Ts, Cs, and Gs in correct order—and to locate its estimated 30,000 to 50,000 genes.