An international research effort (led in the United States by the National Institutes of Health and the Department of Energy) aimed at identifying and ordering every base in the human genome.

Introduction

The Human Genome Project is a huge international scientific project that began in 1990. Its aim is to map all the genes on the human chromosomes.

DNA, genes, and chromosomes

Human cells contain 46 chromosomes. There are 23 kinds and 2 of each kind. The different kinds of chromosomes are given numbers, pretty much according to their size. So the longest chromosome is chromosome 1, the next longest chromosome 2, carrying on right down to the smallest, which are chromosomes 21 and 22.

The 23rd pair are a bit different from the others. These are the X chromosome and the very tiny Y chromosome. Women have two X chromosomes and men have one X and one Y.

Chromosomes are made of DNA. Each chromosome is a long, long DNA molecule. These DNA molecules carry a code – the genetic code – that gives instructions to the cell about what proteins it should make. A length of DNA that gives instructions for just one protein is called a gene. As the DNA molecules in a chromosome are very long, there are many genes on each chromosome. We still don't know exactly how many genes there are on all the 46 chromosomes in a human cell, but many people think it is probably about 40,000. This complete set of genes, found in every cell in a person's body, is called the human genome.

Mapping the genes

DNA molecules are big polymer molecules made up of many similar smaller molecules joined end to end. Each of these smaller molecules contains a base, and there are four kinds of bases – A, T, C, and G. It is the sequence of these bases in the DNA molecule that is the code telling the cell what proteins to make. Change the sequence of bases in a gene, and you change the code and therefore the proteins that the cell makes. This can have an effect on the organism of which the cell is part. It might, for example, make the difference between having red hair or brown hair. Or it might mean that a person with one base sequence has the genetic disease cystic fibrosis and another person with a slightly different sequence does not.

The Human Genome Project is finding out the base sequences in all the DNA molecules in a typical human cell. It is difficult to imagine just what an enormous task this is. It is estimated that the DNA in just one cell contains about 3,000 million bases. Try to imagine a list 3,000 million letters long, that says things like AATGCGGAAGT... That is what the Human Genome Project is finding out.
Many different research laboratories in many different countries are contributing to this project. By 2000, most of the bases in most of the DNA had been sequenced. But this doesn't mean that we know everything there is to know about human genes! We cannot always work out where one gene stops and another starts in this long sequence, and we certainly don't know what they all do.

**Using the knowledge from the Human Genome Project**

There are lots of possible benefits that could come from the Human Genome Project. For example, if we can find out what the base sequence of a 'correct' gene should be, then this may help us to develop gene therapy to replace someone's faulty version of the gene with a correct one. Or perhaps we could work out exactly what protein the faulty gene is coding for and design drugs that stop that protein from working. Or, if we can find ways of quickly checking a particular base sequence on a particular bit of DNA, we might be able to test people to find out if they were carrying a harmful recessive gene. They wouldn't otherwise know they had it, but if they did know then they might decide not to have children, in case they passed it on.

Some of this is already happening. There are already some simple tests to find out if someone is carrying a harmful recessive gene, which can be done just by taking a scraping of cells from inside their cheek, or a blood sample. However, these tests are not 100% reliable, so there is a chance that someone might be given the all-clear when they are actually carrying the gene, or they might be told they have it when they don't.

However, none of this is going to be easy, and you can probably see that we are going to have to be careful how we use our knowledge. Perhaps people would prefer not to know if they are carrying a harmful gene. Perhaps some employers or insurance companies would insist on potential employees or customers being tested for harmful genes that might show up later in life. It is important that as many people as possible – not just scientists – understand what the Human Genome Project is about, so that we can all contribute to the debate about how we use the knowledge that it gives us.
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