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Human Genome Project

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Just over half a century ago, the world was not much aware about the contribution of the genetic factors towards human diseases. The Human Genome Project was initiated to better understand the human DNA

After the first correct description of the double-helix model of DNA (Deoxyribonucleic acid) structure in 1953 by James Watson and Francis Crick; certain methods were developed during 1970's to determine the order, or sequence, of the chemical letters in DNA.

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Genome and Its Importance

All our genes are collectively referred to as genome. In other words, genome is the entire genetic information, complement and all of the hereditary material possessed by an organism. It can be further explained as living creature's genetic material which contains the hereditary instructions for constructing, operating, and maintaining an organism, and transferring life on to the next generation.

DNA comprises of four similar chemicals called bases (A, T, C, and G). In a genome, these bases are repeated millions or billions of times. The particular order of As, Ts, Cs, and Gs underlies all of life's diversifications and even determines whether an organism is human or another species. Thus, in any species, the order of the bases in genomes is pivotal.



An Overview of the Human Genome Project

The Human Genome Project ^[1] (HGP) was a collaborative scientific research program on international scale conducted to discover all the chemical base pairs which make up human DNA for further biological studies. Specifically, its primary goal was to map and identify both physically and functionally, the approximately 20,000–25,000 genes of the human genome. The HGP was going to offer different research perspectives by revealing the genetic factors in human diseases, to help establish new strategies for their diagnosis, cure and prevention.

Although, the Human Genome Project mainly focused on understanding the genetic makeup of the human species, the project also included parallel studies on some selected nonhuman organisms such as *E. coli* (bacterium), the laboratory mouse and the fruit fly. This intensive public effort can be considered as the largest single research projects in modern science.

Human Genome Project

In 1990, the U.S Department of Energy and the National Institutes of Health (NIH) joined with international partners in an expedition to sequence all 3 billion chemical base pairs in the human genome which is the complete set of DNA in the human body. Originally, the project was organized to last 15 years but due to rapid technological advancements, it was completed in spring 2003 thus coinciding with the 50th anniversary of Watson and Crick's model of the basic structure of DNA.

It is believed that the mapping of human genes has marked the beginning of the 'biology century', during which the fields of medicine and health care are going to flourish immensely.

Partners

The federal government administered the involvement of several private sector institutions as well. Celera Corporation carried out a parallel project alongside various other universities and research centers from the United States, the United Kingdom, Canada, and New Zealand. Significant contribution was made by Sanger Center in the United Kingdom as well. These institutes were aided by the U.S. federal government financially and otherwise.

Objectives

Human Genome Project had the following objectives:

- To identify all the approximately 20,000-25,000 genes in human DNA
- To determine the sequences of the 3 billion chemical base pairs that make up human DNA
- To store this information in databases
- To improve tools for data analysis
- To transfer related technologies to the private sector
- To address the ethical, legal, and social issues (ELSI) that may arise from the project.

It was specifically aimed to make, all data generated by the Human Genome Project, freely and rapidly available on the internet so that the medical sciences could prosper around the globe.

Completion

Project's first 5-years plan (1990-95) was accomplished in 1993 due to unexpected progress. Second 5-years plan was marked for completion in 1998 and from there onto the third and final 5-years plan till the completion of the project in 2003.

- In June 2000, the rough draft of the human genome was completed
- In February 2001, the working draft was completed
- In February 2001, working draft sequence and analysis were published in *Science* and *Nature*
- In April 2003, the project was completed and additional papers were published

It's important to mention that some 18 countries participated in this global effort including United States, United Kingdom, Germany, France and Japan.

Impact

The Human Genome Project played a vital role in establishing U.S. as the global leader in the new biotechnology sector by stirring advancement in biotechnology innovation worldwide. The significance of HGP can be highlighted through the following points:

- It has aided the discovery of more than 1,800 disease genes.
- It enabled researchers to find a gene suspected of causing an inherited disease quickly.
- It paved the way for more than 1,000 genetic tests for various human diseases/conditions.
- It resulted in developing 350 biotechnology-based products.
- It laid foundation for the development of the HapMap in 2005 which is a catalog of common genetic variation or haplotypes in the human genome.

It is worth mentioning that the mankind will continue to reap the benefits of the Human Genome Project for long period of coming time.

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Links

[1] http://web.ornl.gov/sci/techresources/Human_Genome/project/index.shtml