The Human Genome and Beyond

U.S. Department of Energy Office of Science Genome Programs

DOEgenomes.org

The human genome—completed!

In 2003 scientists in the Human Genome Project (HGP) achieved a long-sought goal by obtaining the sequence of the 3.2 billion base pairs making up the human genome. The order of the bases A, T, C, and G spells out the exact instructions needed to maintain and reproduce a living organism, whether it's a person, a tree, or a microbe (see Primer, below).

The Human Genome Project 1990–2003

Whose genome is it?

The human genome sequence obtained in the HGP is not an exact match for any single person's genome. Researchers used DNA samples from a number of donors, male and female, protecting the anonymity of all. Because all humans share the same basic set of genes and other DNA regions, this "reference" sequence represents every person.

Exploring genomes on the Web

www.ornl.gov/hgmis/posters/chromosome/

Gene Gateway: a user-friendly guide to the human and other genomes

All Human Genome Project data and much related information are freely available on the Web, but how does a novice find and use these rich resources? Gene Gateway is a new, nontechnical online guide that introduces the various tools anyone can use to investigate genetic disorders, chromosomes, genome maps, genes, sequence data, genetic variants, and molecular structures.

- Gene and Protein Guide
- Bioinformatics Tools
- Genetic Disorder Guide
- Sample Profiles of Genes and Genetic Disorders
- Chromosome Viewer
- Evaluating Medical Information on the Web

Gene Gateway is a Web companion to the popular Human Genome Landmarks poster (see reverse).

A Primer: From DNA to Life

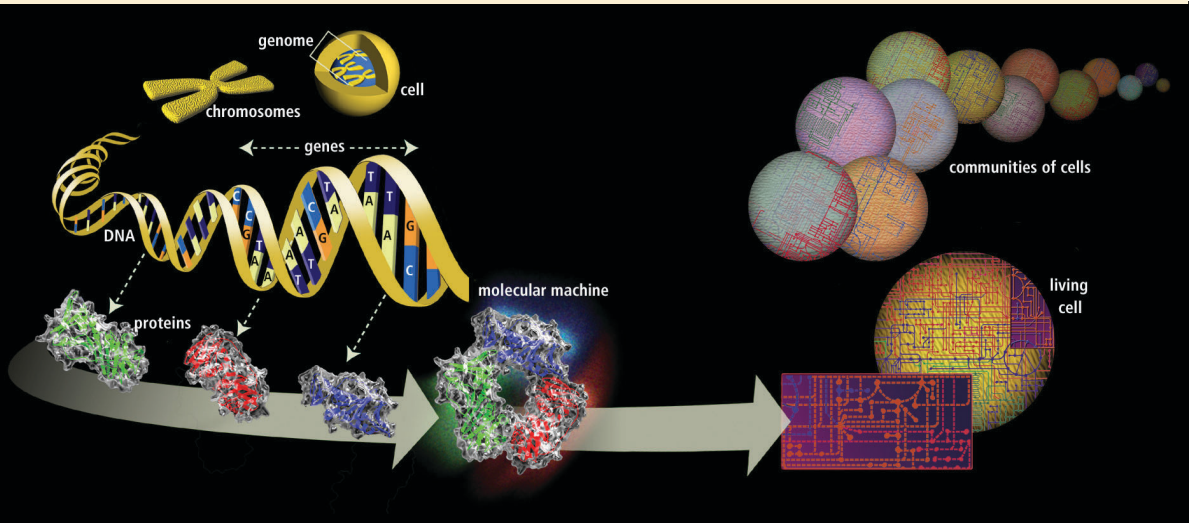
Cells contain DNA—the hereditary material of all living systems.

The **genome** is an organism's complete set of DNA and is organized into **chromosomes**.

DNA contains **genes** whose sequence specifies how and when to build proteins.

Proteins perform most essential life functions, often working together as molecular machines.

Molecular machines interact through complex, interconnected pathways and networks to make the cell come alive.



Communities of cells range from associations of microbes (each a single cell) to the hundred trillion cells in a human being.

Office of Science
U.S. DEPARTMENT OF ENERGY

Beyond the Human Genome Project . . .
What's next?

Genomes to Life: Exploring microbial genomes for energy and the environment

The DNA sequences generated in hundreds of genome projects now provide scientists with the "parts lists" containing instructions for how an organism builds, operates, maintains, and reproduces itself while responding to various environmental conditions. We still, however, have very little knowledge of how cells use this information to come alive.

The Genomes to Life (GTL) program of the DOE Office of Science responds to this new challenge by using DNA sequence data and advanced experimental and computational technologies to explore the life processes of microbes—the amazingly diverse organisms that make up half of the biomass on earth and thrive in every known environment. The ability of this planet to sustain life is, in fact, largely dependent on microbes, most of which do not cause disease. Understanding the intricate details of their functions can eventually enable us to harness their sophisticated biochemical abilities to meet critical DOE mission challenges in energy security, global climate change mitigation, and toxic waste cleanup.

GTL studies will use microbial DNA sequences—many determined in the DOE Microbial Genome Program—as a foundation for studying how tens of thousands of genes and proteins work together in interconnected networks to orchestrate the chemistry of life. This new approach is known as whole-systems biology.

These studies will provide an enduring and comprehensive ability to understand how living cells function and respond to environmental changes—and open the door to applications in energy and the environment as well as across the life sciences landscape, from agriculture to human health.

New Primer Available

Genomics and Its Impact on Science and Society: The Human Genome Project and Beyond (April 2003). A 12-page color document summarizing the HGP, early insights gained, potential future applications, and new scientific challenges.

- Individual print copies or class sets (free)
  Contact: caseydk@ornl.gov, 865/574-0597
- Downloadable via the Web with PowerPoint slides
  www.ornl.gov/hgmis/publicat/primer/

Please send comments to e-mail address above.

Related Web Sites

- Human Genome Project and Beyond
  www.ornl.gov/hgmis/
- Medicine and the New Genetics
  www.ornl.gov/hgmis/medicine/medicine.html
- Ethical, Legal, and Social Issues
  www.ornl.gov/hgmis/elsi/elsi.html
- Genomes to Life
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- Gene Gateway
  www.ornl.gov/hgmis/posters/chromosome/
- Image Gallery (downloadable)
  www.ornl.gov/hgmis/education/images.html
- DOE Office of Science
  www.sc.doe.gov
- DOE Genome Research Programs
  www.ornl.gov/hgmis/
- DOE Joint Genome Institute
  www.jgi.doe.gov
- Microbial Genome Program
  www.ornl.gov/microbialgenomes/
- NIH National Human Genome Research Institute
  www.nhgri.nih.gov
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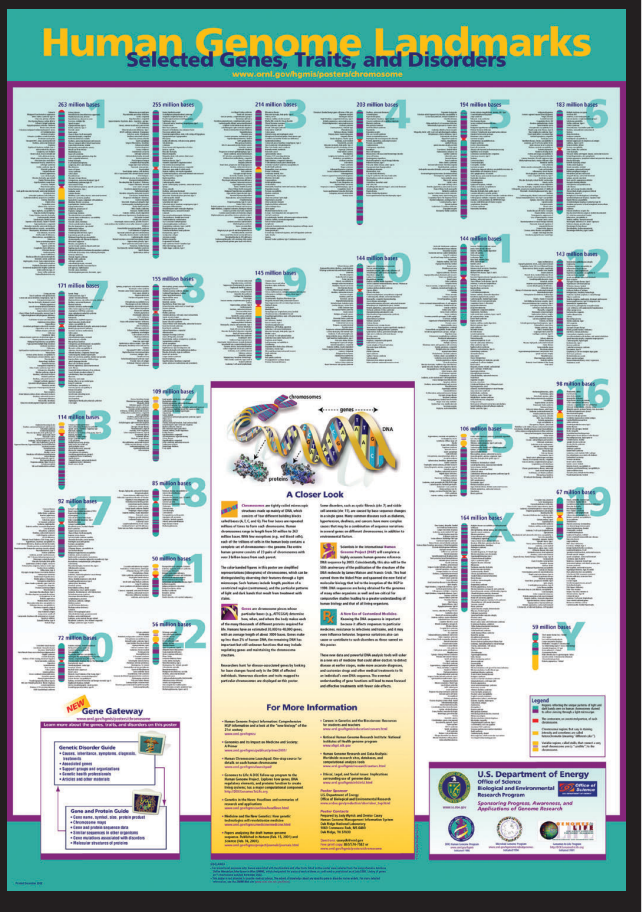
Free Wall Poster of Human Chromosomes

Order via the Web

- www.ornl.gov/hgmis/posters/chromosome/

Or see contact information at left.