

Beyond the Human Genome Project

DOEgenomes.org

In 2003 scientists in the Human Genome Project obtained the DNA sequence of the 3 billion base pairs making up the human genome.

- ▶ The human genome is nearly the same (99.9%) in all people.
- ▶ Only about 2% of the human genome contains genes, which are instructions for making proteins.
- ▶ Humans have an estimated 30,000 genes; the functions of more than half of them are unknown.
- ▶ Almost half of all human proteins share similarities with those of other organisms, underscoring the unity of life.

Many new discoveries yet to come!

The Path Forward

Scientific Discovery

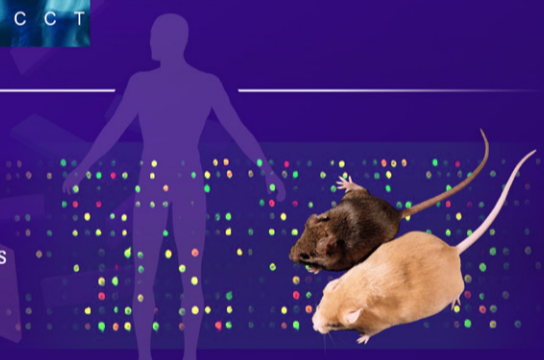
How does DNA impact HEALTH?



Discovery Path
Identify and understand the differences in DNA sequence (A, T, C, G) among human populations

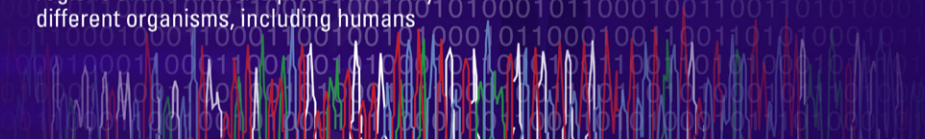
What do all the GENES do?

Discovery Path
Discover the functions of human genes by experimentation and by finding genes with similar functions in the mouse, yeast, fruit fly, and other sequenced organisms



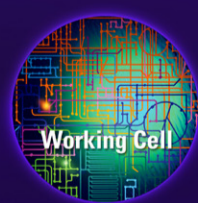
What does most of the human genome DO?

Discovery Path
Identify important elements in the nongene regions of DNA that are present in many different organisms, including humans



How does the genome enable LIFE?

Discovery Path
Explore life at the ultimate level of the whole organism instead of single genes or proteins. The DOE Genomes to Life program provides a foundation for this understanding by using the information found in the genomes of microbes, life's simplest organisms, to study how proteins—the products of genes—carry out all activities of living cells.



Diverse Applications

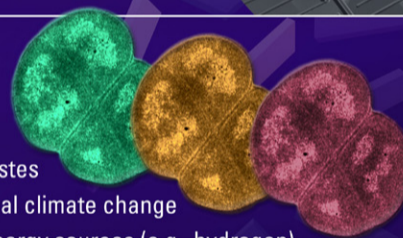
Medicine

- Develop more accurate and rapid diagnostics
- Design customized treatments



Microbes for energy and the environment

- Clean up toxic wastes
- Help mitigate global climate change
- Generate clean energy sources (e.g., hydrogen)



Microbes thrive in every environment on earth, but the vast majority DO NOT cause disease. Understanding them at a basic level will enable use of their diverse and sophisticated abilities.

Bioanthropology

- Understand human lineage
- Explore migration patterns through time



Agriculture, livestock breeding, bioprocessing

- Make crops and animals more resistant to diseases, pests, and environmental conditions
- Grow more nutritious and abundant produce
- Incorporate vaccines into food products
- Develop more efficient industrial processes



DNA identification

- Identify kinships, catastrophe victims
- Exonerate or implicate people accused of crimes
- Identify contaminants in air, water, soil, food
- Confirm pedigrees of animals, plants, foods, wines



The Basics: From DNA to working cells

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

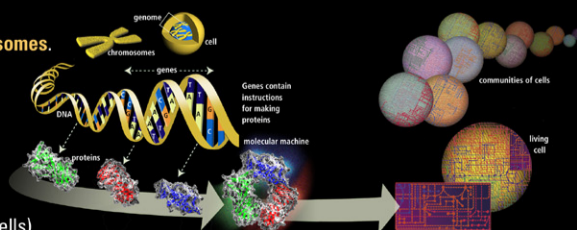
The **genome** is an organism's complete set of DNA and is organized into **chromosomes**.

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 **working cell** come alive.

Communities of cells range from a single human (comprising a hundred trillion cells) to associations of microbes (each a single cell) in a particular environmental niche.



Genome
The Secret of How Life Works

Made possible by **Pfizer**

Smithsonian
Arts and Industries Building
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genome.pfizer.com

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