Beyond the Human Genome Project

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 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 genome—genes in 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. In 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)

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.