

EXPLORING BIOLOGY

GENETICS & EVOLUTION



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Understanding Genetics and Evolution

All living things are made of cells that are packed with unique molecules of deoxyribonucleic acid (DNA). In humans, these genes influence a person's physical features, their personality, and even their health. Over time, genes can slowly adapt to help humans keep up with their ever-changing environments. This is a process known as evolution.

Chimpanzees

Humans and chimpanzees share about 98 percent of their DNA. That is because both species descended from a common ancestor millions of years ago. As humans and chimpanzees evolved, their DNA gradually changed as well, resulting in the differences in appearance and behavior we see from both species today. One difference is that chimpanzees usually have longer jaws and pointier teeth than humans.



Chimpanzees and bonobos are considered the closest living relatives to humans.



Cheek
dimples are
thought to be
a genetic
trait.

The Big Five

The Big Five is a personality framework developed by psychologists to understand and measure human personality. It describes five broad dimensions of genetically inherited traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Each major trait shows how a person behaves, feels, and thinks in different situations.

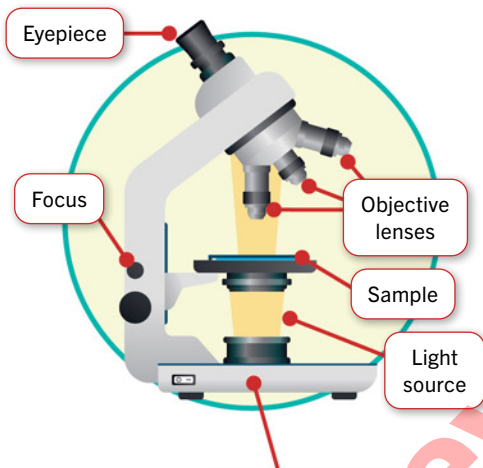


According to genetic studies, about 30 to 60 percent of an individual's personality is inherited.

Studying Cells

One of the basic laws of biology is called cell theory. It says that every living thing has a body made of at least one cell—with many living things containing billions of cells—and every cell developed from an older cell. Looking more closely at cells helps scientists understand how the body works.

Scientists who study cells are called microbiologists. They use electron microscopes to see samples in even more detail.



Light Microscopes

The main tool for studying cells is the light, or optical, microscope. It uses two sets of lenses to magnify tiny objects, allowing scientists to view them in detail. As light shines up through the sample, the first lens focuses the object into a tiny but detailed image. Then, the eyepiece and objective lenses magnify that image. This makes the picture big enough for the human eye to see.

A biological microscope usually has three objective lenses. Each one gives a different magnification level.

Preparing a Sample

The best way to examine cells is to place a thin slice of tissue on a clear glass slide. This slice is bathed in a droplet of water, and a see-through cover is placed on top. This holds the sample still and flat, which helps the lenses focus. Dyes are added to the water to highlight features of the sample. Salts and other chemicals can also be used to observe how the cells operate.



A thin sample allows for light to shine right through, which gives a clear picture of the silhouette of the cells.

HALL OF FAME



Margaret Pittman 1901–1995

As a child, Margaret Pittman assisted her father, who was a doctor, with his patients. Later, she attended the University of Chicago, where she became an expert in bacteria and microbiology. Pittman investigated the bacteria involved in deadly diseases, such as cholera and meningitis.



Scientists can adjust the brightness and position of the light source on a microscope to get a different view of samples.

A pipette is used to add dyes or other chemicals to samples.

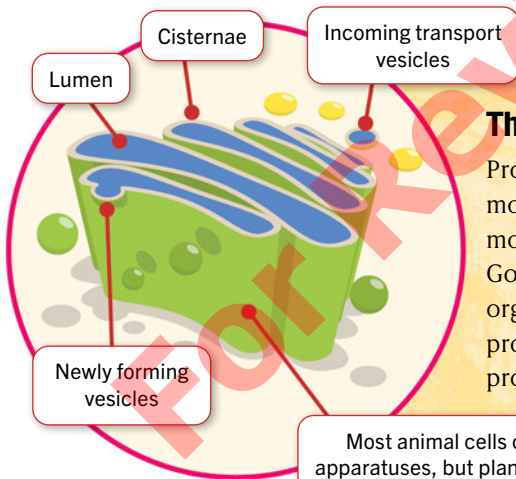
DID YOU KNOW? A light microscope can see objects that are 200 times smaller than the width of a human hair.

Cell Structure

The cells of living things are made of many parts. These structures perform different functions. A gelatinous liquid called cytoplasm that can be found throughout the inside of the cell holds its organelles in place. Tiny mitochondria create the energy to power cells. And the largest organelle in any cell is its nucleus, which contains the cell's DNA and controls all its activities.

Plant and Animal Cells

Plant and animal cells have several differences. Rigid, sturdy outer layers called cell walls surround plant cells, giving them a rectangular shape. Animal cells lack cell walls. This allows them to be many different shapes and sizes. Chloroplasts, unique to plant cells, are used for photosynthesis. This is a process that turns sunlight into energy. On the other hand, animal cells get energy through cellular respiration, which is the breaking down of molecules from food.



The Golgi Apparatus

Proteins are complex molecules responsible for most cellular processes. They are sorted and modified for their jobs within the cell by the Golgi apparatus, which is a folded, sacklike organelle. Then, the Golgi apparatus transports proteins for usage around the cell. It also processes lipids that store a cell's energy.

Most animal cells contain only a few Golgi apparatuses, but plant cells can have hundreds.



Robert Hooke
1635–1703

In 1665, Robert Hooke used a microscope to observe a cork made from bark. Hooke noticed the cork was made up of many different tiny compartments that resembled the living quarters of monks, which were called cells. This gave cells their name and opened the door to further cell research.

The nucleus is protected by a nuclear membrane covered in pores, which allows certain molecules to enter the nucleus as it carries out cell growth and division.

Chloroplasts make plants green. They get their color from chlorophyll.

A plant cell

Endoplasmic reticulum

Nucleus

Mitochondria

The mitochondria help regulate what enters and exits the organelle during its energy-creating processes.

An animal cell

The endoplasmic reticulum is a large organelle that produces a cell's lipids and proteins. It sends the substances to the Golgi apparatus for sorting and processing.

Cytoplasm is made up of mostly water, salts, and proteins. It is held together by a complex network of filaments called the cytoskeleton.