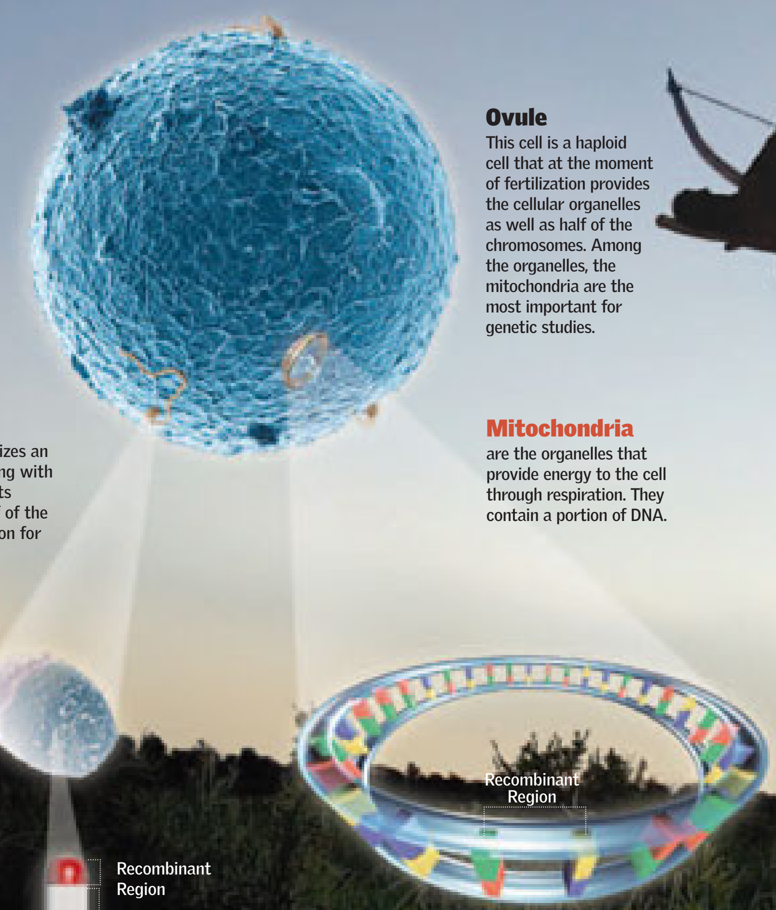
The Genetic Ancestor

Ever since Darwin published his theory about the evolution of species, humans have sought to understand their origin in light of a diversity of ideas and theories. With the success of efforts to map the human genome, old evidence is gaining new strength. Many scientific teams used some 100,000 samples of DNA from all over the world to trace the process of human expansion back to a common ancestor—the "Mitochondrial Eve" that lived in sub-Saharan Africa some 150,000 years ago. She was not the only human female of her time, but she was the one that all present-day women recognize as a common genetic ancestor. The key to the trail is in DNA mutations.

Genetic material

Each time an organism is conceived, its genetic material is a fusion of equal parts received from its parents. Recovering this material throughout history is impossible because of the large number of combinations, so scientists use mitochondrial DNA from the cells as well as DNA from the chromosomes. Thus, following a single path for each sex, the possible combinations are reduced to a set of hereditary lines that are traceable over time. This method is possible when a cell's DNA, along with the various locations of the genes and recombinant areas, is known.



Ovule
This cell is a haploid cell that at the moment of fertilization provides the cellular organelles as well as half of the chromosomes. Among the organelles, the mitochondria are the most important for genetic studies.

Spermatozoon
When a spermatozoon fertilizes an ovule, its tail breaks off, along with all cellular material except its nucleus, which contains half of the necessary genetic information for a new individual.

Mitochondria
are the organelles that provide energy to the cell through respiration. They contain a portion of DNA.

Haplotype

is a set of closely linked alleles on a chromosome.

The Y chromosome

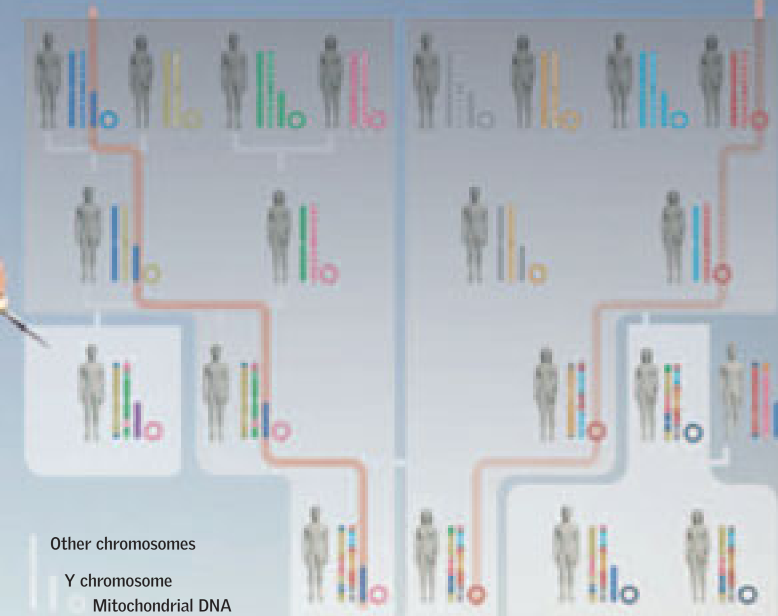
A baby's sex is determined by the sperm cell that succeeds in fertilizing the ovule. Specifically the male gender is determined by the Y chromosome, which is passed on from father to son. To follow a line of ascendant mutations in the recombinant part, the markers of each mutation must be read from the ends to the center to find a common male ancestor. He is called the chromosomal Adam, and he is estimated to have lived 90,000 years ago in Africa.

Mitochondrial DNA

Mitochondria contain circular DNA. This DNA has only one recombinable part, called HVR 1 and 2, where mutations can happen. Over time, the mutations leave marks that can be traced according to their location from the ends to the center. Because mitochondria are inherited from the mother, the mutations can be traced back to a female genetic ancestor. This "Mitochondrial Eve" lived in sub-Saharan Africa about 150,000 years ago. She was not alone at the time, nor was she the only one of her species. However, she was the only one of her community whose genetic inheritance survives.

Genetic Diversity and Phylogenetics

Geneticists have determined statistically that every three generations there is a mutation that will be preserved in the DNA of the descendants. They used this statistic and demographic studies to calculate the age of the "Mitochondrial Eve" and the "Nuclear Adam." If the path of mutations is followed from the present to the past, the line of ascent would lead to these genetic ancestors. However, in reverse, many mutations represent dead ends. That is, they left no descendants for a wide range of reasons. These links are part of the study called phylogenetics and make up well-defined haplogroups. Each haplogroup represents the genetic diversity of a species.

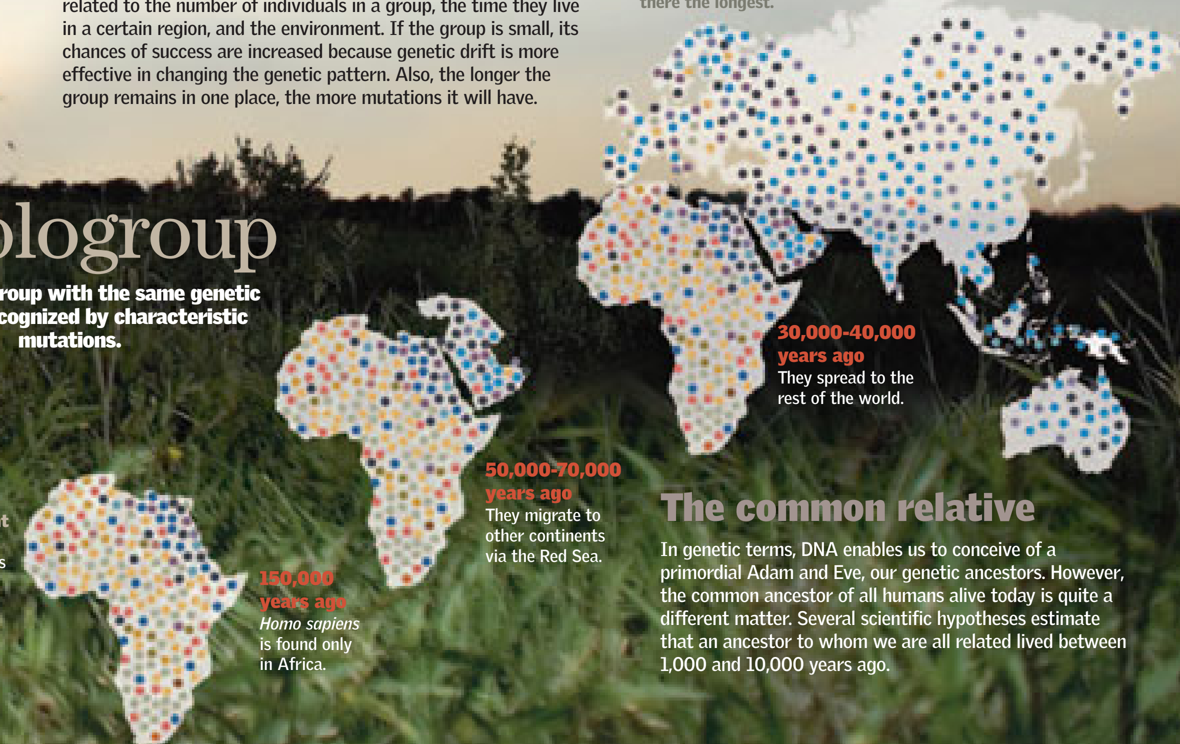


Genetic drift

Each time a mutation occurs, it continues as a mark on future generations. Genetic drift explains how this mutation spreads and how the effectiveness of its spread is related to the number of individuals in a group, the time they live in a certain region, and the environment. If the group is small, its chances of success are increased because genetic drift is more effective in changing the genetic pattern. Also, the longer the group remains in one place, the more mutations it will have.

Haplogroup

is a human group with the same genetic descent, recognized by characteristic mutations.



The common relative

In genetic terms, DNA enables us to conceive of a primordial Adam and Eve, our genetic ancestors. However, the common ancestor of all humans alive today is quite a different matter. Several scientific hypotheses estimate that an ancestor to whom we are all related lived between 1,000 and 10,000 years ago.