

## Genetic Modification vs Selective Breeding

I explain why genetic modification is NOT the same as selective breeding. This is, oddly, a common confusion undoubtedly spawned by the perpetrators of genetic modification.

The basic subjects are chemistry, cellular biology, sexual reproduction, and genetics.

There are a number of basic definitions to master, after which it's pretty straightforward.

The building blocks of chemistry are atoms (like hydrogen) which combine to form molecules (like water). In biology, the building blocks are cells and genes, the latter are the primary units of inheritance.

Genetics involves *chromosomes*, *genes*, *alleles*, and *germ cells*. The nucleus of each cell in the body contains chromosomes. Each chromosome is composed primarily of DNA which has thousands of genes. Each gene controls the development of a specific characteristic of the living organism (such as eye color). Each gene has its own position (or "locus") on its chromosome. Some genes have one or more variants that together comprise a group, one variant of which can occur at the gene's locus. An allele refers to one of a group of genes that can occur at a given locus—an allele is a variant.

Organisms that reproduce sexually commence life as the union of two germ cells—an egg and a sperm. The nucleus of each germ cell contains a fixed number of chromosomes (the number varies by species, there are, for example, 19 in the domestic cat). The joining of the two germ nuclei forms a common nucleus (containing pairs of chromosomes, 19 pairs or 38 chromosomes in the cat) that enables the egg to commence development as an independent entity. In mammals, the fertilized egg is transformed into an embryo and then into a fetus with a body and germ cells of its own.

*Character* refers to a distinguishing inherited characteristic; for example, each aspect of a domestic cat's coat color can be said to be a character. Generally, each character corresponds to a gene. *Expression* refers to the visible appearance (manifestation) of a character.

When a pair of genes (at the same locus in a pair of chromosomes) consist of the same allele, they are said to be *homozygous* for the corresponding character. When a pair of genes consist of two different alleles, they are said to be *heterozygous*.

*Genotype* is the word for the **genetic makeup** of an organism, be it animal or plant. *Phenotype* is the word for the **expression** of the organism's genetic makeup. When a pair of genes are identical (homozygous), the organism's phenotype is the same as their genotype. When a pair of genes are dissimilar (heterozygous), the organism's phenotype may be different from its genotype; in this case, the phenotype reflects the dominant genes.

*Selective breeding* is the process by which humans control the inheritance of traits among a population of domestic plants or animals: deliberately and selectively promoting particular phenotypic traits (characteristics) in domestic animals and plants by choosing which males and females will sexually reproduce and have offspring together. This is a basic practice of agriculture and has been practiced since early prehistory.

Selective breeding does not change the organism's genes and chromosomes. It does limit an individual organism's population of alleles to those that reflect a desired trait.

*Genetic engineering* is the direct manipulation of an organism's genes using biotechnology. It commonly involves the insertion of a gene from a completely different species; for example, a fish gene has been inserted into a tomato. Such changes are believed to be permanent.

The European Commission's Directorate-General for Agriculture and Rural Development has defined genetic engineering as a form of selective breeding, but I believe they are absolutely wrong to do so. (The European Commission is the executive of the European Union.)

Biotechnology and genetic engineering have become big business. GE's little shop of horrors is summarized in the Wikipedia article "Genetic engineering."