Allelic interactions

Types of Allelic Interactions

Dominance

Complete dominance is an interaction between alleles of the same gene, where the function of one allele is completely dominant and in heterozygotes, the dominant allele overlaps the manifestation of the alternative alleles (recessive). The Phenotype of heterozygotes (*Aa*) is thus conditioned only by the dominant allele and is identical to the phenotype of dominant homozygotes (*AA*). For example, consider a gene for coat color that has two forms (alleles). Black coat color is coded by the dominant allele *B* **(*black), brown by the recessive allele* b *(**b**rown). If the individual is heterozygous *Bb*, this means black coloration of the fur just like homozygous *BB*. Only individuals with the genotype *bb* will be brown. At the molecular level, this means that the product encoded by only one dominant *B* allele is of such quality and quantity that the amount is sufficient to cause the coat to become black.

Another example can be two variants of the gene *PAH* (***p****henyl****a***lanine **h**ydroxylase), which encodes the enzyme phenylalanine hydroxylase. Phenylalanine hydroxylase is responsible for converting phenylalanine to tyrosine. Alleles of the gene *PAH* occur in the population in two forms, the dominant allele *A* and the recessive allele *a*, which in recessive homozygotes causes a disorder of phenylalanine catabolism. Dominant "AA" homozygotes, as well as "Aa" heterozygotes, catabolize phenylalanine thanks to the quality and quantity of phenylalanine hydroxylase, whose production is ensured by the dominant allele even in a single dose. Other examples are given for monogenically inherited traits.

🔎 *For more information see Autosomal dominant inheritance, Gonosomal dominant inheritance.*

Recessiveness

As for genes located on autosomes, the action of the recessive allele will manifest itself in the phenotype only in recessive *aa* homozygotes. In a pair with a completely dominant allele (Aa *heterozygotes), the manifestation of the recessive allele is hidden. The same situation applies to women for genes located on the X chromosomes pair (karyotype 46,XX). Women with normal red and green color perception have either a 46,*$X^{+}X^{+}$ *karyotype (dominant homozygotes) or a 46,*$X^{+}X^{rg}$ *(heterozygotes), color-blind women have a karyotype of 46,*$X^{rg}X^{rg}$ *(recessive homozygotes). The phenotypic manifestation of recessive alleles on the X chromosome occurs in men in one dose; red-green males have a karyotype of 46.*$X^{+}Y$ *and color-blind males have a karyotype of 46.*$X^{rg}Y$*.*

🔎 *For more information see Autosomal recessive inheritance, Gonosomal recessive inheritance.*

Incomplete Dominance

Incomplete dominance is characterized by the fact that the phenotype of heterozygotes is different from the phenotype of both types of homozygotes. An incompletely dominant allele will only partially suppress the expression of a recessive allele. In heterozygotes, both alleles participate in the phenotypic manifestation, which does not reach the manifestation of the dominant allele and is more intense than the manifestation of the recessive allele. The combination of different alleles in heterozygotes creates a new form of the trait. A classic example is the color of the flowers of some plants, when, for example, crossing homozygous plants with white and red flowers results in heterozygous offspring with pink flowers.

Codominance

Codominance is the relationship of two different alleles of one gene, when both alleles apply equally and in parallel in the phenotype of a heterozygote. Both distinct parental characters are independent of each other. For example, the gene encoding antigens AB0 blood system occurs in multiple forms in the human population, multiple allele. Simply put, there are three alleles of the AB0 blood system in the population: *A*, *B* and *0*. The three alleles have distinct allelic interactions. The *A* and *B* alleles have a codominance relationship with each other. This means that individuals with the genotype "AB" (heterozygotes) have both antigens equally present on their cell membranes, both blood group antigen A and B. The allele "0" has alleles "A" and " B *relationship recessive. Also, in another blood group system MN, there is a codominance relationship between the "M" and "N" alleles. The codominance relationship also applies to alleles HLA locus (*H**human** L**eucocyte** A**ntigens) that encode histocompatibility (transplantation) cell membrane antigens (in humans, with the exception of erythrocytes).**

🔎 *For more information see Inheritance of Blood Group Systems.*

Links

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