Genetic Diversity

Based on ISIC lectures, and Astrid Indrebø's "Breeders school; genetics and breeding".

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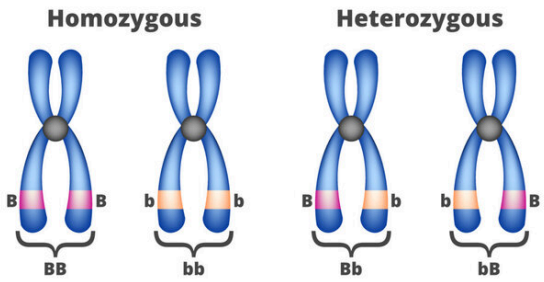
Translated by: Insert Name here

Alleles is one or two more versions of DNA sequence, a single base or a segment of bases, at a given genomic location. Every individual has its own DNA sequence inherited by their ancestors. In a DNA sequence you can have heterozygous alleles or homozygous alleles. Heterozygous alleles means having two different alleles of a particular gene or genes. Homozygous means having two identical alleles of a particular gene or genes.



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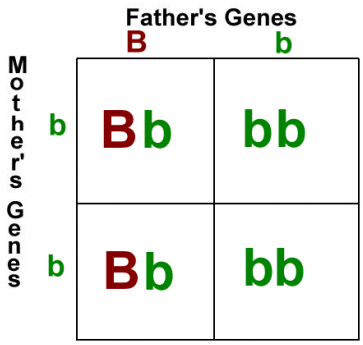

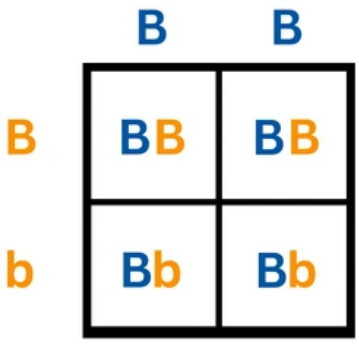

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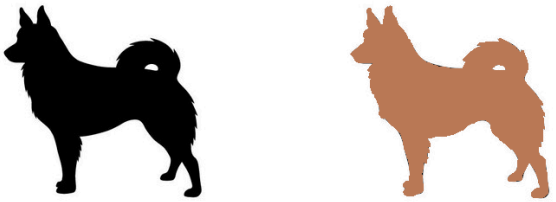
Alleles can either be dominant or recessive. Individuals inherit two versions of each alleles, from each parent. A dominant version of a gene, is a particular variant of a gene, which for a variety of reasons expresses itself more strongly all by itself than any other version of the gene which the offspring is carrying. In the case of a recessive trait, the alleles of the trait-causing gene are the same, and both, recessive, alleles must be present to express the trait. A recessive allele does not produce a trait at all when only one copy is present, in such a case only the dominant trait will express itself. That is how certain traits can be hidden for generations and suddenly appear again.

In the images used, B is the dominant gene and b is the recessive gene. In the first picture the imaginary litter shows both the dominant gene and the recessive gene. That is because the mother only carries the recessive gene and the father carries both a recessive gene and a dominant gene. The second picture is an example where the litter could carry a recessive gene, but only the dominant gene is showing.

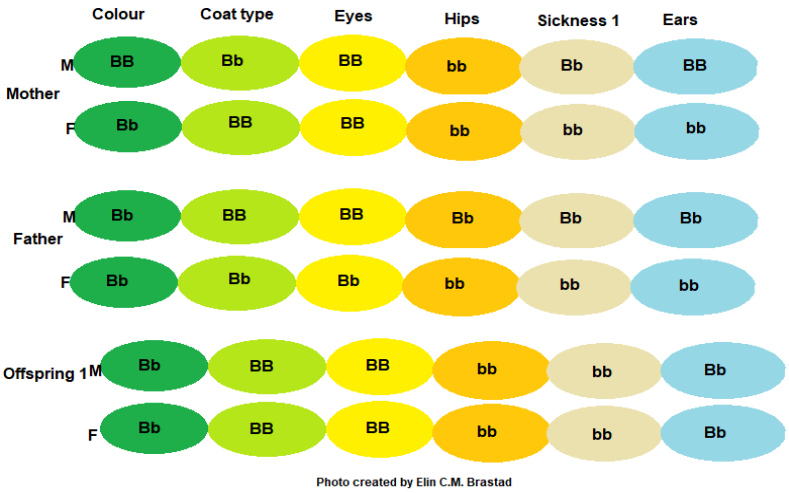


BB or Bb bb

Photo created by Elin C.M. Brastad

In this picture is an example where the colour black is a dominant gene, and the colour brown is a recessive gene. The dominant colour black will express itself where it is present, whereas the recessive colour brown will only express itself when it is alone.

When the genetic material is inherited, the offspring receives a DNA sequence consisting of the mother's two DNA sequences, and a DNA sequence consisting of the father's two DNA sequences. This means that the offspring inherits both dominant and recessive genes from both mother and father in random order.



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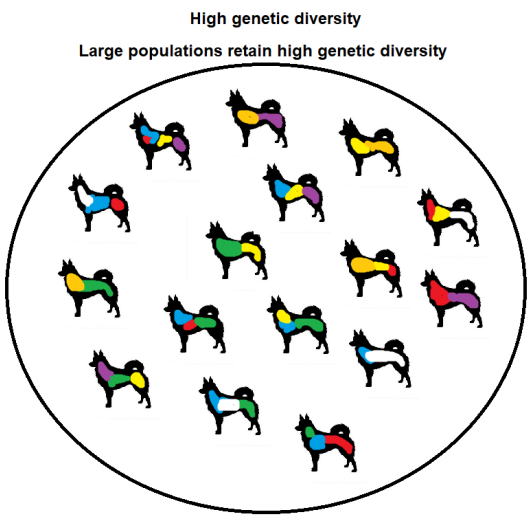

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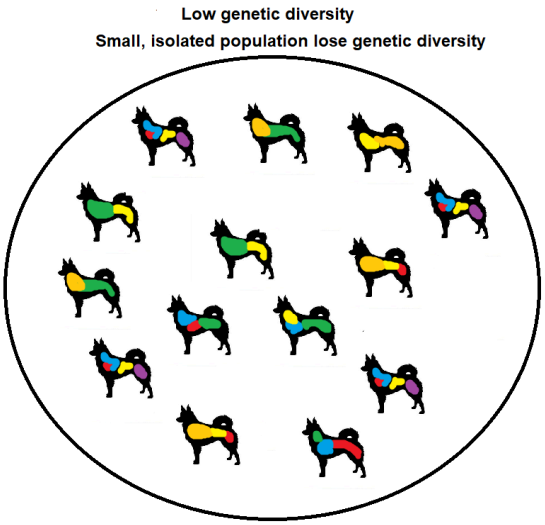
Genetic variation tells us something about how many different gene variants exist in the population for each individual gene; it therefore says something about the proportion of individuals in the population who are heterozygous and homozygous. Genetic variation is a necessity and required for all breeding work and is absolutely crucial for the breeding progress. If there is no genetic variation for the trait we want to improve, it is impossible to improve it. And if there is no genetic variation in that trait, perhaps a disease, that we want to eliminate, it is impossible to breed it away. Mutations and crossovers can be an important contribution to increased genetic variation. Mating of individuals from unrelated families or of different varieties of the same breed can increase the genetic variation in the breed. For instance breeding between a long haired and a short haired dog.

In a numerically small breed population, it is very difficult to avoid inbreeding; the smaller a population is, the more difficult it is to avoid that the individuals are related to each other. The higher the degree of inbreeding in a population, the smaller the genetic variation and the greater the risk of duplication of a defective gene found in the breed that can cause health and/or behavioral problems. If the breed is small in your country, but large worldwide, the solution is simple; you are dependent on cooperation with foreign countries through the use of foreign breeding animals in one or the majority of the litters you raise in your own country, over more than one generation. Another possible remedy is to make sure that the animals used in breeding have the least amount of common ancestors in their pedigree. This will ensure that the possibility for duplications of alleles are low and unwanted or unknown recessive genes will not be dominant.



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Inbreeding results in reduced genetic variation. This not only increases the risk of doubling the unfortunate gene variants found in the breed, but also has many other negative consequences. Research shows that inbreeding increases the incidence of reproductive problems. Breeds with little genetic variation have lower litter sizes, more stillborn puppies and higher puppy mortality. Many dogs are unable to have puppies at all because they are infertile. Inbreeding depression is an expression that is often used in this context. The dogs often have a reduced growth rate, and many end up with a smaller body size. However, dogs that are small as a result of inbreeding depression must not be confused with being genetically small. Inbreeding will also have a negative impact on the dog's immune system. In order to achieve breeding progress over time, breeding should be spread over many individuals. The best should have more offspring than the less good, no one should have too many in relation to the size of the population. See breeding guidelines from ISIC regarding this.

But if the race population on a worldwide basis is very small, what can be done? Very small breed populations will always result in little genetic variation. Importing breeding animals then has little effect because they will not have any new gene variants to contribute either. For certain breeds, there is only one solution, namely crossbreeding with another breed. An example of such a breed is the Norwegian Lundehund. A solution for every breed is to get as many dogs as possible into the breeding work, there are many sofa dogs that are perfectly normal and healthy pets that can be used in breeding.