

## Breeding - Dogs or Pedigrees?

**by Dr. Catherine Marley**

All dogs carry defective genes. These defective genes are usually "recessive" - that is, their expression can be covered up by the presence of a normal gene for that function. It is estimated that the average dog carries 4 to 7 defective genes in its DNA. (The human estimate is 10 to 12). Since genes are always carried in pairs, *most of these abnormal genes are carried in a only single dose*, so that their presence is completely concealed by the other, normal gene.

**What is a gene?** A useful analogy is that a gene is like a set of instructions given to a particular workman doing a small job on a very big construction site. Each workman gets two sets of plans. If one set is damaged, he still has one good set, and the job can proceed. But if both sets are damaged, the job will not be finished, or it will be done wrong. A gene is a large molecule, a long double strand of DNA, composed of a backbone of two long sugar molecules linked by pairs of smaller molecules called "bases" or "nucleotides". It is the sequence of these nucleotides that encodes the information contained in the gene.

**How does a gene become defective?** During normal cell division, an exact copy is made of each and every gene in the cell, and then it divides into two daughter cells which are each an exact copy of the original cell. Defective genes are caused by a "mutation". If something happens to disrupt the exact replication of the DNA during cell division, a defective gene results. Only a few changes in the base sequence can render the information in that gene useless. The process of aging is undoubtedly the effect of accumulated random defects of this sort, as are most types of cancer.

In the formation of egg and sperm, a special type of division takes place. Instead replicating the genetic material, so that both the daughter cells have a full complement of genes (two genes of each type), the genetic material is divided, so that each reproductive cell has only one gene of each type. When sperm and egg finally meet, the full complement of genes is restored, and a new individual, carrying half of its mother's genes and half of its father's genes is created.

**Selective breeding.** Nearly all breeding of domestic animals is selective as opposed to random. Years ago, before the era of scientific genetics, breeding was done more by phenotype than by pedigree.

Race horses tended to be bred by the stopwatch. That was where the money was. Dairy cattle were bred by the volume and quality of their milk, meat animals, by the speed of maturation and ratio of feed to meat, and so on. Later, it was recognized that breeding together closely related animals tended to speed up the process of "fixing" the desired traits within a few generations.

**Breeding by pedigree** is the type of selective breeding most often practiced today. *It nearly always involves some degree of inbreeding.* The logic is simple. We know that an animal's traits are genetically controlled. We can even calculate the percentage of a particular animal's genes residing in the cells of one of its descendants. When we mate closely related animals whose family shows (has the phenotype of) the desired trait, we are reasonably sure it will appear in the offspring. Some breeders have carried this practice to remarkable extremes, failing to realize there is a "catch" to the pedigree method.

**What about those defective genes?** The ones you can't see because they are "covered up" by intact ones. When we breed closely related animals, (let us say because they have super rears), we can see the desired trait. This trait is genetically controlled, like all traits. These two closely related animals share the genes for their super rears as a result of their close genetic relationship. What we can't see is the PRA gene or the kidney disease gene that these two animals also share as a result of their close genetic relationship. When we double up on the good rears we are also doubling up on the particular hidden defects they share.

We can see the results of this type of concentration of mutations in some human populations which have been relatively inbred by reason of isolation due to status, geography, or religion. Some examples that come to mind are Tay-Sachs disease in eastern European Jews, and hemophilia in some royal families.

**Phenotype breeding** has been largely neglected in recent years. It has fallen into undeserved disrepute as the more popular inbreeding has produced faster and more dramatic changes. I say undeservedly, because it has much to recommend it, and avoids some of the serious pitfalls of inbreeding.

Again, we look at the phenotype of two relatively unrelated animals. They both have good rears, which we want. Why do they share this trait? For the same reason that the two related ones did: they both have the set of genes which produce good rears. But what about hidden, bad genes? Since these animals could not have been selected for unseen characteristics, (after all, if you can't see it you can't consciously select for it), they probably do not share many of these defective genes. To be sure, they still carry their load of defects in

their own private collections, but they most likely each carry a different set. This being the case, it is very unlikely that any one offspring will inherit two copies of the same defective gene. It is very likely, however, that they will all have good rears.

**Phenotype breeding is still selective breeding.** We are selecting those animals which show the desired traits, while minimizing the probability of doubling up on hidden, undesired ones. Inbreeding and linebreeding, on the other hand, selects for both the phenotypic and genotypic traits, and dramatically increases the probability of producing animals homozygous for defects.

**The lesson** in all of this is that we should pay less attention to pedigrees, particularly in terms of looking for similarities on paper when we breed, and more attention to the dogs themselves. All too many breeders make their breeding decisions on paper, and not in the flesh. We need to consider the pedigrees as they relate to the qualities of the parent animal - did his mom and dad have good rears - rather than to insist he be related to our prospective brood bitch. We can get the results we want by breeding unrelated "like to like", without the tragic by products of inbreeding.

---

© Catherine Marley, 1997

Return to [The Canine Diversity Project](#)