## Breeders' Briefcase

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# A Beginner's Guide to COI

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**What is COI?**
COI stands for Coefficient of Inbreeding. Essentially, it measures the common ancestors of dam and sire, and indicates the probability of how genetically similar they are.

**Why should I care?**
There are consequences to being genetically similar, some good, some bad. The fact that dogs within individual breeds are so genetically similar is what makes them that breed- and why , if you breed any Labrador to any other Labrador, the puppies will look recognisably like Labradors.

**OK, go on…but please keep it simple..**
Many of the 20,000-odd genes that go into any dog of a particular breed are 'fixed'. That means that every Labrador will have two identical copies of them- one inherited from their dam; one from their sire. Others however, are not so fixed – such as those genes in Labradors that code for colour. That is, Labradors can come in black, chocolate and yellow.
Genes always come in pairs. The gene-pair is called an 'allele'. When the pair is identical, it is called 'homozygous'. When the pair is not identical, it is called 'heterozygous.' 'Allele', 'homozygous' and 'heterozygous' are three good words to understand if you are a dog breeder. Homozygous and heterozygous are terms often used more generally, too, when talking about diversity. The more gene-pairs that are homozygous = less diversity. The more gene-pairs that are heterozygous = more diversity. Geneticists in the main consider diversity a good thing.

**So not all the pairs of genes are identical?**
Correct. And this is what gives us variation within a breed. It's why, as mentioned above, Labradors come in three colours. And it's also what makes some bigger or shorter or faster or cleverer or more able to withstand disease than others. Of course environment can play a big role too, but the raw potential for every dog lies in its genes.

**I thought we were talking about COI?**
Many pedigree breeds are already highly homozygous, ie many of their alleles contain only a single gene type. This means that the characteristics that these genes produce will be the same in all puppies, regardless of which parents from the breed are used (ie no breed diversity) The COI is really just measuring the probability of any individual allele being homozygous due to an identical gene being passed down to the puppy along

both the dam and sires lines from single common ancestors.

**Give us a dead simple example**

1. Breed two completely unrelated Labradors
2. Mate two of their offspring together
3. What is the resulting puppies' COI?

In this instance the puppies' COI will be 25% – that is, statistically, there is a 25% chance that any allele will contain the exact same gene as a direct result of having common ancestors – in this instance the same grandparents. This is in addition to the levels of homozygosity that would be present in the breed regardless.

**You say 'statistically'?**

Yes, in reality, they could be much more than 25% genetically identical/homozygous – or much less. The only way to know for sure would be to minutely examine every dog's DNA which would be impossible (at the moment at least). But the statistical likelihood is nevertheless very useful to dog breeders.

**What about other COI examples?**

Parent/offspring: 25%
Full sibling: 25%
Grandparent/grandchild: 12.5%
Half sibling: 12.5%
Great grandparents/great grandchild: 6.25%
First cousin: 6.25%

**What about other common ancestors?**

COIs are much more than looking at a dog's parents. COIs also track how related dogs are further back in the pedigree. Look back 10 generations in our own family trees and you are very unlikely to see the same name twice. This is not true for dogs, though. The same names can appear many, many times. Traditionally, breeders have very commonly used grandfather/grand-daughter matings (and often even closer) to 'fix' certain traits. To get a true picture of how inbred a certain dog is, then, you should go back at least five generations and ideally ten. As you go further back, in most instances, the COI is likely to rise.

**Why are high COIs considered a problem?**

Two reasons:

1. Inbreeding will help cement 'good' traits but there's a danger of it also cementing bad ones. In particular, it can cause the rapid build up of disease genes in a population.
2. Even if a breed of dog is lucky enough to be free of serious genetic disorders, inbreeding is likely to affect our dogs in more subtle, but no less serious, ways.

These include smaller litter sizes, less vigorous/viable puppies, fertility problems and weakened immune systems. These effects have been very well documented in other species and are known as inbreeding depression. Farmers, who used to breed livestock in much the same way as we still breed dogs, have now changed the way that they breed their animals. In fact farmers so recognise the benefit of hybrid vigour that much of the meat we eat, milk we drink and eggs we boil are from crossbreeds. That's because the yield is likely to be more/healthier/disease resistant than that from purebred stock.

A study of Standard Poodles discovered that dogs with a COI of less than 6.25% lived on average four years longer than those with COIs over 25%.

Now nothing in genetics is inevitable.

There are some examples out there of very inbred populations that appear to be pretty healthy and whose fertility/fecundity have not been affected. But the above effects have been observed far too often to ignore the risk. While a low COI does not guarantee a healthy puppy, a high COI should definitely be a cause for concern.

**Why bother to check a dog's COI?**
As well as limiting further genetic problems, having a low COI may show that the breeder has tried to follow good breeding practice and limit inbreeding. This hopefully will reflect in other good practices such as socialisation and worm control so that your new puppy will be happier and healthier in many respects.

**How do I check my dog's COI?**
You can check your prospective puppy's COI (or COI of both parents) by going to the Kennel Club's online Mate Select programme: http://www.the-kennel-club.org.uk/services/public/mateselect/Default.aspx Click on *Individual Inbreeding Coefficient*.

**Breed Average COI**
These vary enormously. A recent study carried out by Imperial College showed breed averages for the 10 breeds studied of around 4%. Within each breed though, there were enormous differences, with many dogs in the KC database with COIs over 25% (the equivalent of a mother/son mating)

**Important Caveat**
COIs are not the be-all and end-all of a dog. They're just one measure. So don't freak out if you discover your dog has a ten generation COI of 30%. Likewise, if your dog has a COI of only 1% it does not guarantee his health and fitness but his chances of having inherited a double dose of defective genes is far less.