GREYHOUND RACING VICTORIA

Developing a breeding program - understanding genetics

Breeder Booklet No. 2

This is the second in a series of booklets developed to support the successful breeding of racing greyhounds.

Booklet 1:
Thinking about breeding greyhounds

Booklet 2:
Developing a breeding program – understanding genetics

Booklet 3:
Starting a breeding program

Booklet 4:
Care and husbandry in the breeding environment

Booklet 5:
Reproductive anatomy - getting pregnant

Booklet 6:
Pregnancy

Booklet 7:
Whelping

Booklet 8:
Care and early development

Date published 2019

Developing a breeding program

Basic breeding principles

The actual science of genetics can be daunting although there are many good references that can help breeders better understand genetics and how dogs inherit traits from their parents.

All pups get half of their genes from their mother and father

The genes can be thought of as the 'instructions' for building a racing greyhound

The genes a pup receives from each parent is random, with some pups getting more of the 'good genes' than others. No two littermates have the exact same genes (unless they are identical twins)

All greyhounds carry some 'good' genes and some 'bad' genes. No matter how good the parents are on the racetrack they will all have the potential to produce some pups that may not have a successful racing career.

Certain traits are more likely to be passed on - they have what is called 'high heritability'.

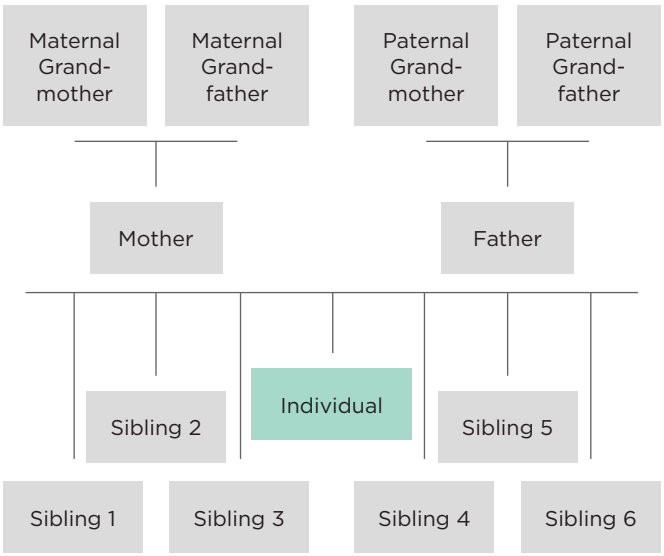
Temperament traits such as aggression or fearfulness are **highly** heritable - this means if you use a greyhound that is aggressive you are more likely to produce pups that are aggressive.

Progeny records are a list of the pups from a breeding greyhound. They are by far the most important indicator of a male's or female's ability to produce successful pups. It is important to keep records of all pups so that the information can be used to decide whether to breed from the parents again.

The genes form your greyhound's 'genetic potential' which is then influenced by other things such as nutrition, disease or injury, exercise, handling and general environment (important during rearing). A well-bred greyhound, without good nutrition and care may never actually reach its full potential. Conversely, all the good food and care in the world is not going to turn a poorly bred greyhound into a great athlete.

Basic inheritance models

Greyhounds have a genetic 'blueprint' that they inherit from their parents. The blueprint contains thousands of genes, each gene coding for a particular biological process that together will determine everything from shape and structure, to coat colour and temperament of the greyhound. Genes are carried in groups along 'chromosomes' and scientists have mapped the gene sequences for canines.



Humans have selectively bred animals for their size, colour, looks or purpose for thousands of years - taking the animals with the preferred traits and breeding them together. As a result, we now have different 'breeds' of animals, animals that excel at certain tasks such as herding or hunting, and animals that produce food for humans more efficiently. By understanding how individual traits may be inherited, a breeder can look to maximise success and minimise diseases in their greyhounds.

If you are seriously considering breeding, start to think about understanding basic breeding principles - well before breeding is to take place.

Simple 'dominant' and 'recessive' traits

Each greyhound receives two copies of each gene - one from their mother and one from their father. Each gene may have a number of different possible types called 'alleles' and the allele type that a greyhound receives from one parent may be not be the same as the allele type from the other parent.

In many cases the presence of one allele (inherited from one parent) may dominate (or override) the presence of the other allele (inherited from the other parent). A good example may be a gene that determines the coat colour of greyhounds. These genes are easy to study as the greyhound will be one colour or another - so it is easy to see which gene types the greyhound has!

Example: Coat Colour A greyhound may have either the 'black' gene or the 'blue' gene. If the black trait is 'dominant' it means that any greyhound that has at least one copy of the black gene will have a black coat. In genetics, the dominant allele is usually a capital letter, so we will call black - 'B'. The blue coat allele is then called recessive and is indicated with a lower-case letter - 'b'. Each greyhound has two copies of the allele, so they can be represented as:

- '**BB**': these greyhounds have two copies of the same black allele - they will have a **black coat**.
- '**bb**': these greyhounds have two copies of the same blue allele - they will have a **blue coat**.
- '**Bb**': these greyhounds have one copy of each of the black and the blue alleles - they will have a **black coat** as the black is dominant to blue, but they are considered 'carriers' of the blue gene.

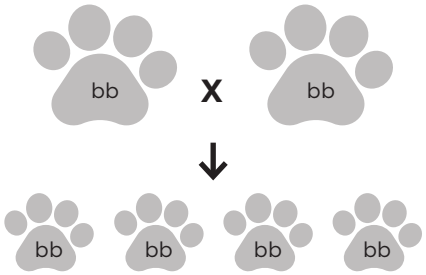
Using the blue and black coat colour as an example of genetics, below in Table One, there are various mating combinations.

bb x bb	BB x BB	BB x bb
Bb x bb	Bb x BB	Bb x Bb

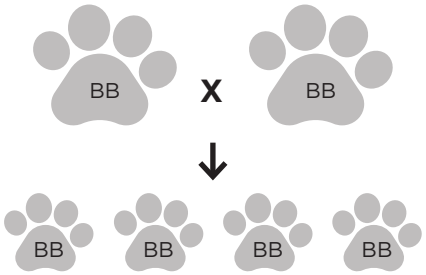
You can see how these combinations reflect in a greyhound coat in Table One below.

Remember that the mix is random. You cannot not know just by looking at a greyhound whether or not the black coated greyhounds you see in the litter are carriers of the blue gene or not. Over time, and with different combinations of parents, it is often possible to work backwards through the pedigree and determine what a greyhound's alleles are based on their pups and what their pups have produced.

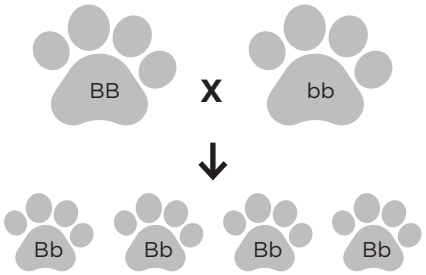
Table one: Mating combinations



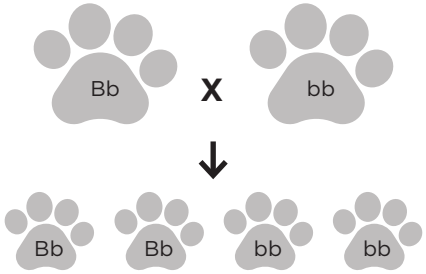
If you bred two **blue** coat greyhounds, you can see below that the only gene they could each contribute to the pup would be a 'b' - **blue** coat gene, so all resulting pups would be **blue**.



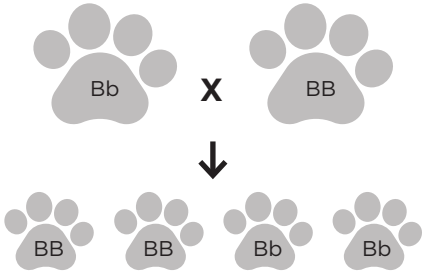
Similarly, if you bred two **black** coat, 'BB' greyhounds together, all they could each contribute to a pup would be a 'B' gene so therefore all of the pups would be 'BB' and would have **black** coats.



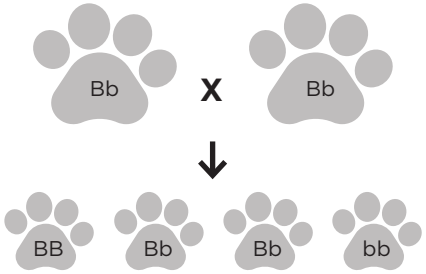
If you bred a 'BB' **black** coated parent to a **blue** coated (bb) parent, then the black parent could only give a 'B' gene and the **blue** parent could only give a 'b' gene, so all of the pups would be 'Bb' and would have **black** coats (but all would carry the **blue** coat gene).



If you took a parent that had a **black** coat, but who 'carried' the **blue** gene (Bb) we could get either 'B' genes or 'b' genes passed on to the pups. If these 'carriers' are mated to a **blue** coated greyhound the pups will get a 'b' **blue** coat gene from the blue parent and could get either a 'B' or a 'b' from the carrier parent. This means, on average, half of the litter will be 'Bb' and will have **black** coats but carry the **blue** coat gene, and the other half of the litter will be 'bb' and will be **blue**.



If you took one of these **black** coated 'carriers' 'Bb' and mated them to a black coated 'BB' (who does not carry the **blue** gene), the resulting possible combinations would be 'BB' or 'Bb' depending on which gene they got from the carrier parent. All of the pups would have **black** coats, but approximately half of them could carry the **blue** gene.



This combination mates two **black** coated parents that both carry the **blue** gene. Each parent could either pass on a 'B' or 'b'. This means that the resulting pups could be 'BB' (getting a 'B' gene from each parent), a 'bb' (getting a 'b' gene from each parent), or they could be a 'Bb' (getting a 'B' gene from one parent and a 'b' gene from the other parent). On average you get a ratio of 1 BB: 2 Bb: 1 bb in the pups - which means on average for every 4 pups in a litter, there will be 3 that have **black** coats (2 of which will be carriers of the blue gene) and 1 **blue**.

Genes coded for speed, anxiety or disease

As we have stated, genes are not only coded for things like coat colour. They are also coded for things such as speed, anxiety or a disease. In theory, if the 'fault' - such as anxiety - was a dominant trait and caused affected greyhounds to be anxious in a racetrack setting or other complex environment, then breeding from them would result in anxious pups. However not breeding from these greyhounds would eventually remove that gene from population.

Very few diseases or genetic faults are caused by dominant genetic traits. Instead, most of the genetic diseases and genetic faults we see in breeding animals tend to be caused recessive genetic traits. With recessive traits, often the first you will know about it in your breeding animals is two 'carrier' animals are mated together, and suddenly an 'affected' greyhound is produced from two seemingly normal parents. The other complication is that what you see (for behavioural issues such as anxiety) is also affected by environmental factors (including rearing, handling and socialisation).

Many diseases and/or conditions caused by genetic faults are now able to be detected with DNA testing.

Sex-linked traits

When animals get their genes from their parents there is one special chromosome that has the coding for the sex of the pups - the 'X' and 'Y' chromosomes.

- Females have 2 copies of the 'X' chromosome ('XX');
- Males have one 'X' and one 'Y' ('XY'), so the 'Y' chromosome is what makes a male develop into a male.

The genes for some diseases may also be housed on this 'X' or 'Y' chromosome, meaning that some diseases only occur in males, and some diseases only occur in females.

Of course, the examples given here are very simple examples of how genetic transmission of a trait occurs. There are a lot of variations on the simple dominant and recessive mode of inheritance. There is 'partial dominance' (where the dominant gene is not 100% dominant), 'multi-gene inheritance' (where multiple genes code together for a single disease or trait), 'co-dependence' (where one gene influences the expression of another gene) and many more.

The problem breeders face is trying to weigh up all the genetic traits they want and don't want in a greyhound. This is followed by then trying to find a compatible mate for that greyhound that will combine safely to produce pups that also have the desired traits and lack of undesirable traits when the possible combinations of genes are almost infinite.

As a breeder, you not only have to be aware of the defects that you are trying to avoid, but you also need to understand how they are inherited so that you can make breeding choices that will avoid producing pups with the same problems.

GREYHOUND RACING VICTORIA

www.grv.org.au