Basic Color Genetics for Cockapoos:

You may ask, why should I learn about basic color genetics in dogs? Well, have you ever bred a chocolate dog to another color (black or buff), and gotten NO chocolate puppies out of the litter? Seems strange, but it happens quite often. Or, are you trying to get some of those gorgeous chocolate and white parti colored puppies you see out there, but can't seem to find the right match of male and female? What about that ever elusive dark red color? These are all things that are determined by the color genetics in your dogs. Learning about some basic genetic concepts can help you to be more knowledgeable in your choice of which dogs to match up in breeding and in finding new breeding stock to add to your program.

Remember high school biology? Probably not, but that's where we begin.

The first thing to learn is that all of us, including our dogs, have 2 copies of every gene that we have. The location of each of these series of genes is known as the locus. Each gene series controls a certain set of traits. We (and our puppies) inherit one gene of each series from each parent. For our puppies, we are looking at factors such as coloring, silvering, sabling, merling, length of coat, and curliness of coat, just to name a few.

For each of these genes, there are dominant genes, designated by capital letters ("B" or "E"). These are the ones that dominate, so only one needs to be present in order for the trait to be expressed. There are also recessive genes, designated by lower case letters ("b" or "e"). These genes are the "weaker" genes, so two of these same genes must be present in order for the trait to be expressed. If a dog has one dominant gene and one recessive gene, we say that the dog "carries for" the recessive trait. This may seem a bit confusing, but I think you'll get a better grasp on the concept as we look at practical examples relating to our dogs.

The two most common traits that affect color genes in Cockapoos are the B series, for brown coloring and the E series for yellow coloring. These are the two genes that will be dealt with in this article. In essence, "b" designates brown, and "B" shows the lack of brown. Likewise, "e" designates yellow coloring, and "E" will show up as a lack of yellow. There are more technical explanations for all this, but we'll leave all that out for now.

In Cockapoos, we call brown, "chocolate." The color can vary from a light, caramel type brown, to a dark, deep chocolate. A dog will be chocolate if he has 2 recessive genes for brown, or "bb." If he has a dominant "B", on the other hand, either "Bb" or "BB", he will be a non-chocolate color, which could be some light color, black, or sable—basically, anything but chocolate. This gene affects not only the coat color, but the nose, skin, and eye color as well. When the coat is brown, the nose is also brown, and their eyes are usually hazel or green instead of the typical brown.

In Cockapoos, the "yellow" coloring is identified as red, apricot buff, or cream. When a dog has 2 recessive genes for yellow, he is "ee" and will be "yellow" in color. If he has a dominant "E", either "Ee" or "EE" he will NOT be yellow in color, but some dark color, like chocolate, black, or sable (sable can be confusing because it starts out a dark chocolate type black, and fades to a yellowish color over time).

To really understand how the B and E series of genes work together, it his helpful to see what color each combination will produce in a dog. Also, you can see pictures of some dogs that have these color combinations *(LINK TO MOMS AND DADS PAGE)*. Please note that we are not addressing issues such as parti colors, phantoms (black and tan points), sabling, silvering, merling, etc. at this time. These factors are caused by different genes and will be addressed in later articles.

In the following descriptions, "carries for" means that the dog has one recessive gene, but does not exhibit the trait. He/she can potentially produce puppies of this color, if matched up with another dog that exhibits or carries the trait.

Color Combinations

There are 9 combinations of color produced by the combined "B" and "E" genes. ***(Link to our website for specific examples for each combination.)*** These combinations are as follows:

BBEE: Black, does NOT carry for chocolate, does NOT carry for yellow

BBEe: Black, does NOT carry for chocolate, carries for yellow

BbEE: Black, carries for chocolate, does NOT carry for yellow

BbEe: Black, carries for chocolate, carries for yellow

bbEE: Chocolate, does NOT carry for yellow

bbEe: Chocolate, carries for yellow

BBee: Yellow, does NOT carry for chocolate

Bbee: Yellow, carries for chocolate

bbee: Yellow with liver (rose) nose; carries 2 genes for chocolate (called caramel in the Labradoodle breed)

Notice that when there are 2 recessive genes for both the chocolate and the yellow genes, as in the last example, the yellow will be dominate; however, the underlying brown will be demonstrated by a liver (rose) nose and also results in green eyes.

Punnett Square (Examples)

The best way to see the combinations that can be produced in a litter of puppies is by creating a Punnett Square. Here are two examples that show how our knowledge of our dogs' genes can help us to predict the type of litter that will be produced by matching certain dogs.

When two dogs breed, the puppies will get one "B" or "b" from each parent, and one "E" or "e" from each parent. The following match is from a chocolate dog that carries for yellow (bbEe) (shown across the top row) and a buff dog that carries for chocolate (Bbee) (shown in the left column).

bbEe & Bbee	bE (1st & 3rd genes)	be (1st & 4th genes)	bE (2nd & 3rd genes)	be (2nd & 4th genes)
Be (1st & 3rd)	BbEe Black	Bbee Yellow	BbEe Black	Bbee Yellow
Be (1st & 4th)	BbEe Black	Bbee Yellow	BbEe Black	Bbee Yellow
be (2nd & 3rd)	bbEe Chocolate	bbee Yellow (liver nose)	bbEe Chocolate	bbee Yellow (liver nose)
be (2nd & 4th)	bbEe Chocolate	bbee Yellow (liver nose)	bbEe Chocolate	bbee Yellow (liver nose)

This litter should produce 25% black puppies, 25% chocolate puppies, 25% yellow puppies with black noses, and 25% yellow puppies with liver noses—half of the litter dark-colored, and half light-colored.

Please be aware that the probability of this is much like flipping a coin. Probability tells us that 50% of the time the coin will fall to heads, and 50% it will fall to tails. This may play out differently in reality. Likewise, when you have a litter of only 4-8 puppies with Cockapoos, on average, the colors of puppies that "should" be born in a particular litter may be in very different proportions.

Now look at the combination of puppies that would be produced by breeding a chocolate dog that does NOT carry for yellow (bbEE) (across the top row) with a buff dog that does NOT carry for chocolate (BBee) (in the left column):

bbEE & BBee	bE	bE	bE	bE
Be	BbEe Black	BbEe Black	BbEe Black	BbEe Black
Be	BbEe Black	BbEe Black	BbEe Black	BbEe Black
Be	BbEe Black	BbEe Black	BbEe Black	BbEe Black
Be	BbEe Black	BbEe Black	BbEe Black	BbEe Black

The results tell us that 100% of the puppies produced from this match will be black. While the puppies produced in this litter would make excellent choices of breeding stock, because they would definitely carry for both chocolate and yellow, it would be an entire litter of blacks, which is not desirable to most breeders.

This does not take into account sabling, merling, parti markings, or silvering. Sabling is not fully understood, but seems to occur in the BbEe combination if at least one parent has the sable gene (discussed later).

Conclusion

Understanding the color genes in your dog's DNA is useful knowledge that can help you produce more of the desirable colored puppies as well as understand why you get the colors you do in a particular pairing. This knowledge of basic color DNA will also assist you in further understanding some of the more complex situations such as parti colors, phantom, sable, merle and silvering.