Some Coat Colors of Poodles Studied using DNA Testing

We included Poodles in some of our DNA studies over the years, and the dogs below represent some of these. Some of this information is repeated on the pages about dogs in general. It is placed here so that Poodle owners can view the information relevant to their breed on a single page.

This pdf began as a webpage that was last updated on June 1, 2008 by Sheila Schmutz. Some information was updated in November 2020.

We are grateful to the owners who allowed us to take cheek brush DNA samples of their dogs or to those who submitted samples by mail at our request.

Poodles have several basic colors: red, black, brown and cream/white. We do not understand which gene/s causes white yet but we do understand the genes causing red, black and brown. However Poodles also have many shades of these colors and the genes involved in some of these are now understood too, in 2020. In the process, we are rejecting some previously held beliefs, supporting others, but can not explain

Standard Poodles, Miniature Poodles and Toy Poodles are all considered Poodles and could theoretically be interbred. However it seems more of the smaller Poodles have coat colors outside the few solid ones typical in most of the Standards. At the bottom of the page there are some examples of these more rare colors that are not accepted in the Standard in many countries or registries.

K Genotypes

The K locus is the gene beta-defensin 103. All Poodles that are black, blue or brown (chocolate) produce eumelanin pigment and therefore have at least one K^B allele. Many poodles are likely homozygous K^B/K^B . Black that is inherited as a dominant, is caused by having at least one copy of the K^B allele plus at least one copy of the E or E^M allele. This is the black that occurs in Poodles.

Pixie, left, has not retained intense black coloration. She must have an allele at some other gene that influenced that intensity of pigment. Zachary, at the right, has retained his deep black pigmentation into adulthood.

Although dogs may be black by two different genetic mechanisms, only "dominant black" occurs in Poodles. Dogs that have two "*a*" alleles at the agouti locus inherit black as a recessive trait. They are unable to make red pigment since their agouti gene is not functional. This allele occurs primarily in herding breeds.

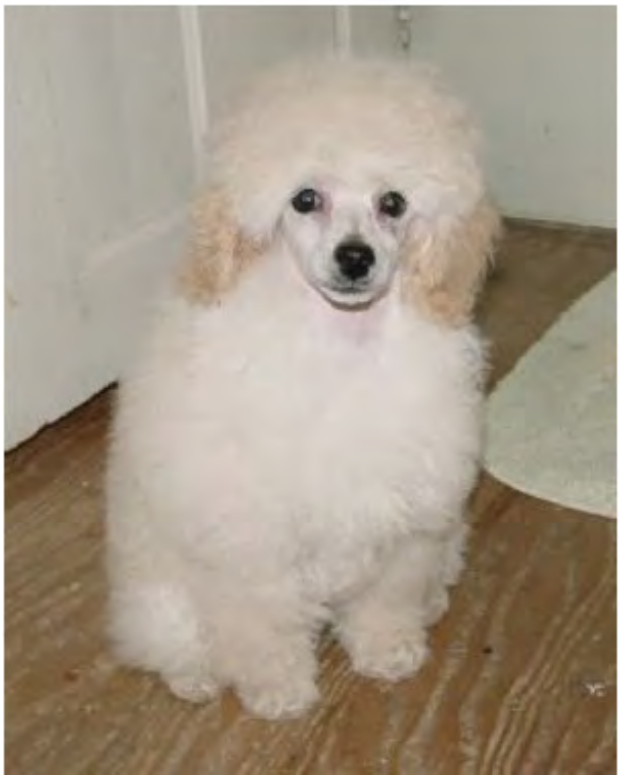
E Locus

Red

There are two genetic mechansims by which dogs can be reddish in coat color. The first one is inherited as a recessive, *e*/*e* at the E locus which is the MC1R gene. This is the yellow of Labrador Retrievers and also the red of Irish Setters, so the shade can vary tremendously. *e*/*e* dogs are "clear red" without a single black hair or even whisker.

Some Poodles are *e*/*e* at *MC1R* and in the case of these dogs, one can not predict their K genotype. Such *e*/*e* dogs could be K^B/K^B or K^B/k^y and still not be black since the *e*/*e* genoytpe prevents black pigmentation of hairs in dogs (but not nose leather or pads).

Poodles that are *e*/*e* are often cream or apricot, such as Molly. Such paler shades of red are caused by another gene.



The other form of red is "fawn red", called "sable" in a few breeds of dogs, such as Shetland Sheep Dogs. This fawn red is caused the dominant allele a^y at the agouti or A locus. This form of red also occurs in the Poodle. Some dogs have black whiskers or some black hairs intermingled in their coat, but not all with this genotype have black hairs.

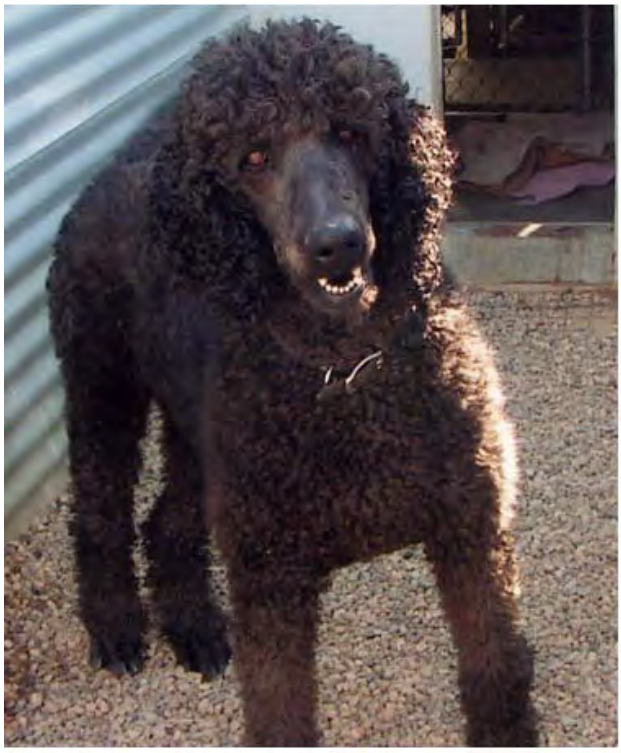
Shay is an example of a red Poodle that is caused by a^y that does not have any black hairs but did have hints of black tips on her hairs as a pup. This type of red seems to be more common in small Poodles and necessitates a k^y/k^y genotype as well as an a^y allele.

"Melanistic Mask" which is caused by the E^M allele means there are eumelanin pigmented hairs on the muzzle. E^M is the top dominant allele at the E locus. In other words, $E^M > E > e$ in its effect on phenotype.

But, since all traditional Poodles are solid colored, the melanistic mask would not show on a black or brown dog. Lacey has an E^M but since she is a solid color, the only hint is that her ears are darker. There is no sign of a darker muzzle. Lacey has lightened with age and in dogs with an E^M allele, the lightening process doesn't always affect the muzzle and ears quite as much as the rest of the body.

Brown, B Locus Genotypes

Tyrosinase Related Protein 1 (*TYRP1*) is the gene responsible for brown coat colors in dogs (and mice and cattle and cats). Three different mutations in this gene all can produce brown. An example of a brown Standard Poodle is shown on the left. All dogs with *b/b* genotypes also have brown nose leather, lips, eye rims, and pads.



Pale Shades of the Colors

Because Poodles have at least two genes causing pale shades and both can occur in the same dog, this has been very difficult to study in this breed. Furthermore it seems that not all breeders use the same terminology to distinguish the dilute colors. Although I present the following dogs as examples, I can not guarantee that they have only one of the two genotypes.

The locus causing "born blue or "dilute" black is classically known as the D locus. Some poodles have the common mutation we have detected in *MLPH* that causes dilute in many breeds. This allele is known as "*d*". However, poodles also can turn pale because of a single copy of *G* (see below for the explanation of progressive graying) and a few poodles are probably *d/d* and *G/-* which is essentially double dilute, but probably is no paler than either genotype alone would cause.

In most breeds we would call the dilute of *MLPH* "born blue". Some breeders suggest that the color changes from black to blue in these dogs, but more quickly than with a *G*. This would not fit the typical biochemistry of this gene but perhaps this may be true in Poodles.

Blue, D Locus Genotypes

"Blue" is used as the name for diluted black in Poodles and many other dog breeds. It is used by geneticists for "born blue", not the gradual change to grey that occurs in some Poodles which is called "grey". Apparently "silver" is a common term in Poodles that may be used to describe the color but not the genetic cause.

Celena, the Standard Poodle, bottom left, was called a "silver" by its owner. Zoe, the Standard Poodle at the right is called a "blue" by her owner. Zoe has the genotype K^B/K^B and *D*/*D*. So although Zoe was born blue, she does not have the common mutation in *MLPH* that causes blue in several other breeds. Celena is also *D*/*D*, and lacking this mutation. In the last few years, several other mutations have been identified in *MLPH* and it's probable that both of these poodles are homozygous for one of these.

Some breeders of blue Poodles suggest that all change from dark to lighter but that some change in a matter of weeks and others take much longer. A few people use the term "bluebells" for some blue Poodles. Color dilution alopecia affects several breeds that have mutations in *MLPH*. Not all dogs loose hair, but in several breeds this happens.

Brown can also be diluted by a *d*/*d* genotype to a paler brown, as shown by Flutey on the right. Flutey is b^c/b^c at the brown locus.

Remy is a Standard Poodle that is called "Cafe-au-lait". Remy has a *b*/*b* genotype but we have not tested whether she is d/d or G/-. However since she was born and has stayed this shade, we presume she is *d*/*d*. Specifically Remy is b^S/b^d, but which brown alleles a dog has does not explain the shade of brown.

Apricot and Cream

The photo above dramatically illustrates the effect of a co-dominant phaeomelanin diluter gene. The hair clippings are from Toy poodle ears: red, apricot, and cream. Their dam was a black that was not diluted even though she must carry this allele to have a cream pup. All poodles with this shade of cream that we have tested are *e/e* at *MC1R*.

In 2019, Hédan et al. published that the mutation that caused dogs that were expected to be red, were cream instead is in the *MFD12* gene. Cream poodles are homozygous for this mutation and apricot poodles are heterozygous. Red poodles do not have this mutation.

White

Some Poodles, both Standard and smaller are born white. The gene causing this absence of any pigment in the hair is **not yet known** in any breed. Some of these poodles have black skin. We differentiate these from the cream poodles.

Silver, G Locus Genotypes

Little (1957) described graying as a progressive change resulting in a lightening of the hair coat as the dog ages. He suggested that this could be a dilution gene but it is not like the Weimaraner dilution gene, which causes pups to be born a diluted color and remain so. The gene that causes this progressive graying in dogs, **has not yet been discovered as of 2020**. This Standard Poodle demonstrates the effects of this gene in a very dramatic way. The small black spot by her neck is the result of a rabies vaccination! It will take a long time for that black hair to change to silver.

Nose Pigmentation


Scooter, left, has black nose and pad pigment. Royce, right, has brown nose pigment and pads. The nose and pad pigment, sometimes called "points" in Poodles is caused by the *B* versus *b* alleles.

Rare Colors

Some rare patterns or colors occur, especially in the smaller Poodles. These patterns are not recognized for showing purposes by AKC or CKC. They are presented here for educational purposes only.

Phantom

Many breeds adopt a new term for a pattern that exists in other breeds, which is rather unfortunate and very confusing. "Phantom" is the term used in smaller poodles to describe the black-and-tan pattern common in many other breeds. Phantom poodles such as the one shown here, must have a k^y/k^y genotype plus an *E* or E^M, and also be a^t/a^t. This particular dog has at least one E^M allele, based on the back on its muzzle.

Sable

Pippin is an example of another dog that is k^y/k^y but he has an a^y allele. As a young pup at the left, the black tips on his hairs are very evident. By 10 months of age, he had lightened over most of his body but still has apricot ears with black fringe because of his E^M allele.

Shay, shown far above, did not have an E^M allele or progressive greying ($G/\_$) so remained a deep reddish and just lost the black tips on his hairs.

Particolor

Particolor is the term used in several small breeds to mean there are white spots on the dog, often in random places. Although some of these dogs are more white than colored, it is the absence of color in the white areas that is the mutation from wild type, not the presence of colored areas. The gene causing this type of random spotting in several breeds is *MITF.* The same mutation causes particolor in Poodles as in spotting in the other breeds we've studied. Blaze is an example of a Standard Parti who is homozygous for this mutation. Parti is inherited as recessive to solid color, so both parents must carry it for it to occur in a litter.

• Rothschild M.F., Van Cleave P.S., Carlstrom L.P., Glenn K.L., Ellinwood N.M. (2006) Association of MITF with white spotting in Beagle crossed dogs and Newfoundland dogs. Animal Genetics 37, 606-607.
• Karlsson, Elinor K., Izabella Baranowska, Claire M Wade, Nicolette H C Salmon Hillbertz, Michael C Zody, Nathan Anderson, Tara M Biagi, Nick Patterson, Gerli Rosengren Pielberg, Edward J Kulbokas III, Kenine E Comstock, Evan T Keller, Jill P Mesirov, Henrik von Euler, Olle Kampe, Ake Hedhammar, Eric S Lander, Goran Andersson, Leif Andersson & Kerstin Lindblad-Toh. Efficient mapping of mendelian traits in dogs through genome-wide association. Nature Genetics online October, 2007
• Schmutz, S.M., T. G. Berryere, D. L. Dreger. 2009. *MITF* and White Spotting in Dogs: A Population Study. Journal of Heredity 100:S66-S74.

For more general information, please see **Genetics of Coat Color in Dogs**
http://munster.sasktelwebsite.net/DogColor/dogcolorgenetics.html

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