What's Behind the Three Different Colors of Labrador Retrievers?

And Are There More Than Three Colors?

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A black lab puppy and chocolate lab puppy playing. Source: akc.org

Labrador retrievers are some of the most popular dogs on the planet and arguably (or perhaps inarguably, in the author's opinion…) one of the best dog breeds in the world. Historically bred to be retrieving dogs in Canada[1], Labs have a friendly easy-going temperament that makes them great family pets, but they are also super intelligent and have the work ethic and trainability to make great service dogs, search and rescue dogs, or police dogs. Plus, let's face it, Labrador puppies are some of the cutest things you'll ever see.

Labs typically come in one of three colors: black, yellow, or chocolate (brown). Recently, there's been a controversial influx of so-called 'silver' Labradors, which has stirred a fair amount of contention among lab enthusiasts. Currently, only the first three colors- black, yellow, and chocolate- are acceptable according to the breed standard[1].

How are the three different coat colors inherited? Where are new colors like silver coming from? Why are many breeders beginning to explicitly state that they are 'dilute free'[2]?

Well, the three traditional coat colors depend on two genes: the E gene (technically called the MC1R gene) and the B gene (technically TYRP1)[3]. These two genes determine whether a lab puppy is yellow, brown, or black[3].

How does that work? Well, there are two slightly different versions of each gene, called '**alleles**'. In the case of the **E** gene, there is a capital **E** allele and a lowercase **e** allele. The **B** gene has a capital **B** allele and a lowercase **b** allele. Each dog gets two alleles for each gene, one from its mother and one from its father, and the combination of alleles a dog gets is called its **genotype**. For example, if a dog got two capital **E** alleles and two capital **B** alleles, it would have a genotype of **EEBB**.

Different alleles have different effects on an organism's appearance, or **phenotype**. For instance, a dog with two big **B**'s (genotype **BB**) would be a different color than a dog with two little **b**'s (genotype **bb**).

In other words, **genotype determines phenotype.**

But how do we know that are there two genes that determine color? Since one gene has three possible genotypes (for example, **BB**, **Bb**, and **bb** for the B gene), it seems logical that a single gene could be responsible for the three phenotypes (coat colors) seen in labs. However, the B gene can only produce two phenotypes, not three, due to **dominance**: the dominant allele, capital **B**, **masks the expression** of the recessive allele, lowercase **b**. Therefore, a dog with a **Bb** genotype has the same phenotype as a dog **BB** genotype, and even though there are three possible genotypes for the B gene (**BB**, **Bb**, and **bb**), there are only two possible phenotypes (because **BB** and **Bb** produce the same phenotype). The same dominance pattern occurs in the E gene with the dominant **E** allele and recessive **e** allele.

Individually, the E gene or the B gene could only produce two phenotypes (coat colors) and not the three coat colors seen in labs. Therefore, we need both genes, E *and* B, to interact with each other to produce the three different phenotypes seen in Labradors.

WHICH GENOTYPES LEAD TO WHICH COAT COLOR?

Let's start with the E gene. When a dog has at least one capital **E** allele, it will be **BLACK** or **BROWN**[3]. On the other hand, if a dog has two little **e**'s on the E gene, the only possible color it can be is **YELLOW**[3]. The little **e** allele is referred to as a **'LOSS-OF-FUNCTION' ALLELE** and it results in the inability for the dog to produce the black or brown color[3].

The B gene determines if a lab with at least one capital **E** will be black or brown. Capital **B** is dominant to lowercase **b**, and it codes for the color **BLACK**. Little **b** codes for **BROWN**. So, a dog with a **BB** or **Bb** genotype would have a **BLACK** phenotype, and dog with a **bb** genotype would have a **BROWN** phenotype.

WANT TO TEST YOURSELF? FIGURE OUT WHAT COLOR LAB PUPPY YOU WOULD GET FROM EACH GENOTYPE BELOW!

A) EEBb B) EEbb C)eeBB

GENOTYPE	PHENOTYPE
EEBB EEBb EeBB EeBb	 Black
EEbb Eebb	 Chocolate
eeBB eeBb eebb	 Yellow

Labrador genotypes and corresponding phenotypes. Photos from: birddoglabs.com

ANSWERS:

A) Genotype: EEBb, phenotype: Black
B) Genotype: EEbb, phenotype: Brown
C) Genotype: eeBB, phenotype: Yellow! *Don't forget that the dog can't be black or brown unless it has at least one capital **E** allele!*

So now you know how lab puppies can be yellow, black, or chocolate.

But what about **SILVER** labs? Silver labs have become somewhat trendy recently, as their unique coat color sets them apart from your everyday lab. On the other hand, many breeders are adamant that silver labs shouldn't be produced or even claim that they are not purebred Labradors[4]. This has led to a pretty big controversy in the lab world between breeders and breed enthusiasts with different opinions about silver labs, as well as the related colors, charcoal and champagne.

These new-fangled Labrador colors are all the result of what is known as color **DILUTION**[3]. Silver labs, for example, are chocolate labs that have a genotype resulting in a diluted chocolate color that looks like a

mix between grey and brown. Charcoal labs are diluted black labs and champagne labs are diluted yellow labs. Dilution is seen in many dog breeds, so these colors are not an unheard-of phenomenon, but Labrador Retriever registries do not accept these color variations[1].

Silver (diluted chocolate) lab puppy
Source: Pinterest

Charcoal (diluted black) lab
Source: Pinterest

Champagne (diluted yellow) lab
Source: Hargrove Heaven Farm Labradors

The gene that results in diluted coat colors is referred to as the 'D' gene (technically known as the MLPH gene)[3,4]. Once again, dominance is at play, so the **D** allele dominates over the **d** allele[5], and if a dog has a genotype of **DD** or **Dd**, it will not be diluted in color. Labs of the three traditional colors- black, yellow, and chocolate- all have a genotype of **DD** or **Dd** at the D gene. However, if a dog has two little **d**'s (a genotype of **dd**), then coat color dilution occurs. As in the E gene, the little **d** allele is a loss-of-function allele that prevents the coat color from being fully expressed and therefore results in a diluted color[5].

HERE ARE SOME GENOTYPES TO PRACTICE ON! WHAT COLOR PUPPY WOULD BE PRODUCED BY A GENOTYPE OF…

A) EEBBDD
B) EEBBdd
C) eeBBdd
D) EeBbDd

ANSWERS:

A) Genotype: EEBBDD, Phenotype: Black
B) Genotype: EEBBdd, Phenotype: Charcoal
C) Genotype: eeBBdd, Phenotype: Champagne
D) Genotype: EeBbDd, Phenotype: Chocolate

So that all seems pretty straight forward…just one more gene is acting to produce another three coat colors. What's the uproar about?

Well, for one thing, breed enthusiasts tend to be purists, whether they are lab enthusiasts or enthusiasts of any other breed. Some Labrador enthusiasts simply think that the lab should stick to the three accepted colors because that's what the breed standard describes and what labs have looked like historically (although this point is somewhat debatable).

There are also some more tangible reasons that some lab enthusiasts are against allowing silver, charcoal, or champagne labs to be added to the breed standard. First, some people believe that the **d** allele, which leads to color dilution, was added to the Labrador breed via out-breeding labs to other dog breeds such as the Weimaraner[4]. This would mean that silver labs- or other diluted labs- can't be considered pure bred Labradors.

One final consideration that many breeders are worried about is a condition known as Color Dilution Alopecia (CDA) which is characterized by progressive and permanent hair loss in the affected dog. This

condition has been observed in some but not all dilute dogs[3], suggesting that **dd** dogs are predisposed to the condition but that other unknown factors are at play when it comes to developing CDA. However, Labrador breeders cite the risk of CDA as a reason to avoid producing dilute Labradors.

In the end, the controversy of silver Labradors means very little. Am I a Labrador enthusiast and, somewhat unavoidably, a Labrador purist? Yep. Do I think breeders producing silver/charcoal/champagne Labs are doing so simply because it's a trend and they can make quick cash? Yes. But in the end, the only color of a lab that matters is the color of its heart…and, in my opinion, that is always gold.

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