



**JOJO**



DNA Test Report

Test Date: April 20th, 2019

embk.me/jojo71

## BREED MIX

 Labrador Retriever : 100.0%

## GENETIC STATS

Wolfiness: 0.9 % **MEDIUM**

Predicted adult weight: **53 lbs**

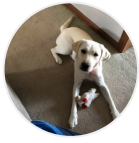
Genetic age: **35 human years**

Based on the date of birth you provided

## TEST DETAILS

Kit number: EM-6542296

Swab number: 31001809355211



**JOJO**

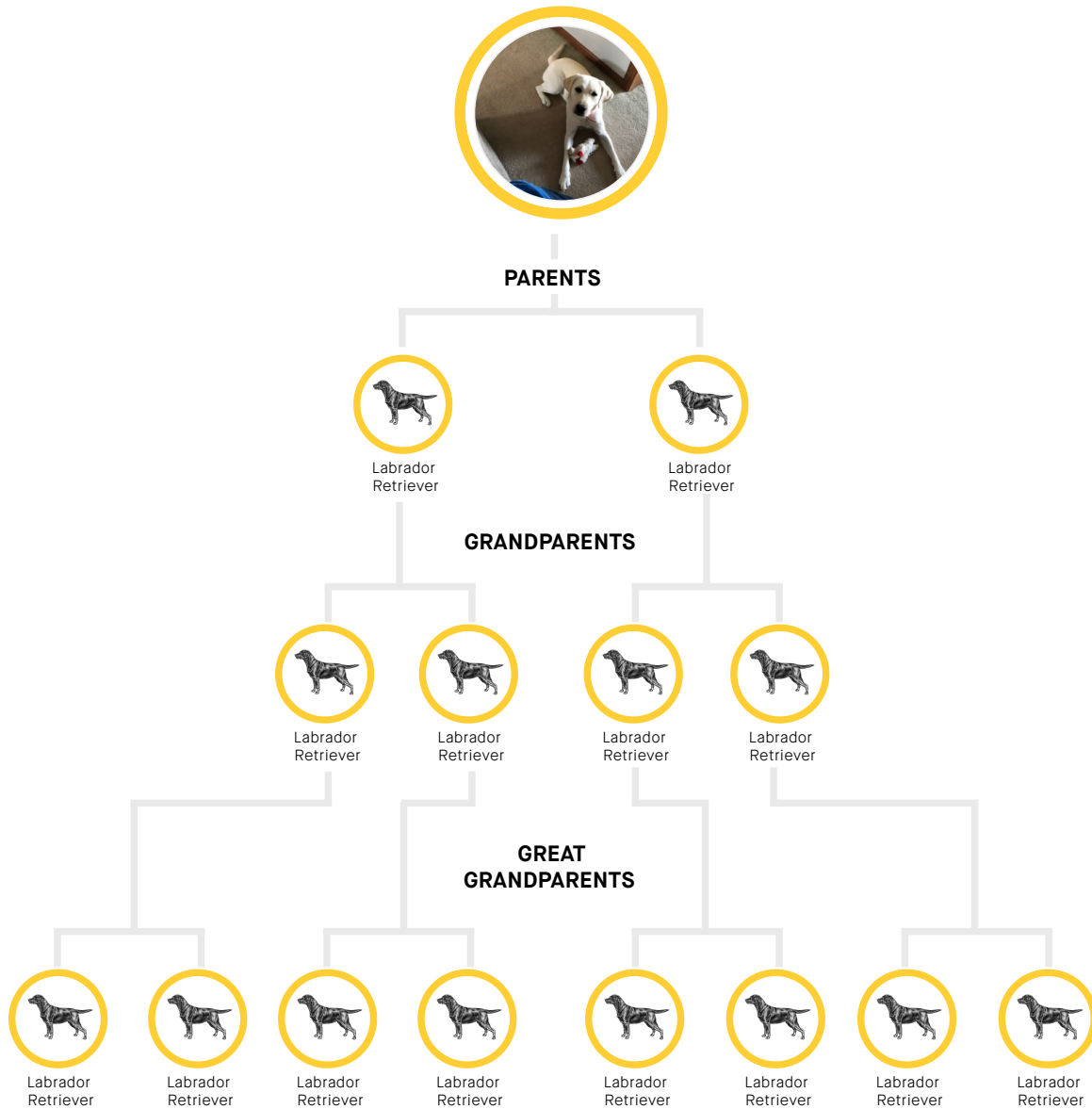


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## FAMILY TREE



Our algorithms predict this is the most likely family tree to explain JoJo's breed mix, but this family tree may not be the only possible one.



**JOJO**

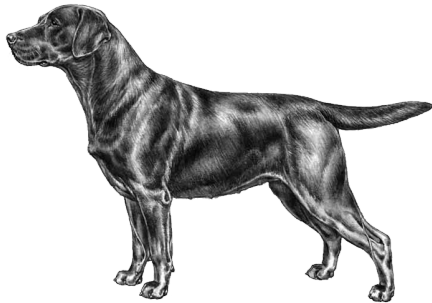


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## LABRADOR RETRIEVER



The Labrador Retriever has been the most popular AKC breed in the United States every year for the past 25 years. Their origins have been traced to the St. John's dog, named for the capital city of the Canadian province "Newfoundland and Labrador." The St. John's was developed from imported European dogs for fishing and hunting on the island of Newfoundland in the 18th century. During the 19th century St John's were bred in England and developed into the Labradors we know and love. Labradors were recognized as a breed by the British Kennel Club in 1903 and by the AKC in 1917. With their friendly dispositions and weatherproof build, they are terrific family dogs and outdoor companions. Most Labradors are very active with an appetite to match, and need plenty of exercise. Labradors often love to swim. Their double-coated weather-resistant fur can cause heavy shedding. Great hunting dogs and popular household companions, Labrador Retrievers are also employed as guide dogs and search-and-rescue dogs.

### Fun Fact

We're pretty sure Labradors came from the island of Newfoundland, and many experts believe that the Newfoundland breed was developed in neighboring Labrador! By our calculations, there are 10 times as many Labradors in North America than there are people living in Labrador and Newfoundland.

### RELATED BREEDS



**Flat-Coated Retriever**  
Sibling breed



**Golden Retriever**  
Sibling breed



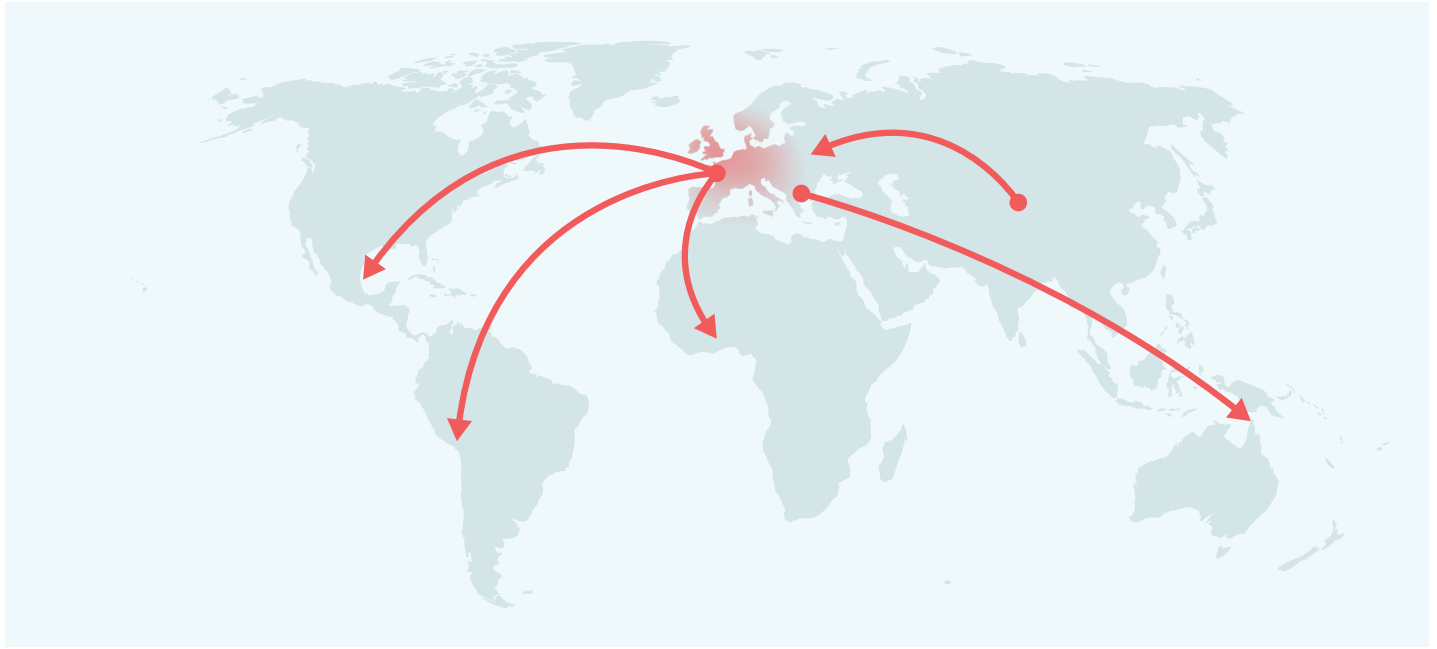
**Chesapeake Bay Retriever**  
Cousin breed



**Newfoundland**  
Cousin breed



## MATERNAL LINE



Through JoJo's mitochondrial DNA we can trace her mother's ancestry back to where dogs and people first became friends. This map helps you visualize the routes that her ancestors took to your home. Their story is described below the map.

### HAPLOGROUP: A1a

A1a is the most common maternal lineage among Western dogs. This lineage traveled from the site of dog domestication in Central Asia to Europe along with an early dog expansion perhaps 10,000 years ago. It hung around in European village dogs for many millennia. Then, about 300 years ago, some of the prized females in the line were chosen as the founding dogs for several dog breeds. That set in motion a huge expansion of this lineage. It's now the maternal lineage of the overwhelming majority of Mastiffs, Labrador Retrievers and Gordon Setters. About half of Boxers and less than half of Shar-Pei dogs descend from the A1a line. It is also common across the world among village dogs, a legacy of European colonialism.

### HAPLOTYPE: A382

Part of the large A1a haplogroup, this haplotype occurs most frequently in Labrador Retrievers, Golden Retrievers, and Chesapeake Bay Retrievers.



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## TRAITS: BASE COAT COLOR

<b>TRAIT</b>	<b>RESULT</b>
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**Dark or Light Fur** | *E (Extension) Locus* | Gene: *Melanocortin Receptor 1 (MC1R)* | Genetic Result: **ee**

This gene helps determine whether a dog can produce dark (black or brown) hairs or lighter yellow or red hairs. Any result except for **ee** means that the dog can produce dark hairs. An **ee** result means that the dog does not produce dark hairs at all, and will have lighter yellow or red hairs over their entire body.

**Light colored fur  
(cream to red)**

**Did You Know?** If a dog has a **ee** result then the fur's actual shade can range from a deep copper to yellow/gold to cream - the exact color cannot be predicted solely from this result, and will depend on other genetic factors.

**Red Pigment Intensity LINKAGE** | *I (Intensity) Loci* | Genetic Result: **Dilute Red Pigmentation**

Intensity refers to the concentration of red pigment in the coat. Dogs with more densely concentrated (intense) pigment will be a deeper red, while dogs with less concentrated (dilute) pigment will be tan, yellow, cream, or white. Five locations in the dog genome explain approximately 70% of red pigmentation intensity variation across all dogs. Because the locations we test may not directly cause differences in red pigmentation intensity, we consider this to be a linkage test.

**Any pigmented fur  
likely white or cream**

**Did You Know?** One of the genes that influences pigment intensity in dogs, TYR, is also responsible for intensity variation in domestic mice, cats, cattle, rabbits, and llamas. In dogs and humans, more genes are involved.

**Brown or Black Pigment** | *B (Brown) Locus* | Gene: *Tyrosinase Related Protein 1 (TYRP1)* | Genetic Result: **BB**

This gene helps determine whether a dog produces brown or black pigments. Dogs with a **bb** result produce brown pigment instead of black in both their hair and skin, while dogs with a **Bb** or **BB** result produce black pigment. Dogs that have **ee** at the E (Extension) Locus and **bb** at this B (Brown) Locus are likely to have red or cream coats and brown noses, eye rims, and footpads, which is sometimes referred to as "Dudley Nose" in Labrador Retrievers.

**Likely black colored  
nose/feet**

**Did You Know?** "Liver" or "chocolate" is the preferred color term for brown in most breeds; in the Doberman Pinscher it is referred to as "red".



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## TRAITS: BASE COAT COLOR (CONTINUED)

<b>TRAIT</b>	<b>RESULT</b>
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**Color Dilution** | *D (Dilute) Locus* | *Gene: Melanophilin (MLPH)* | Genetic Result: **DD**

This gene helps determine whether a dog has lighter "diluted" pigment. A dog with a **Dd** or **DD** result will not be dilute. A dog with a **dd** result will have all their black or brown pigment lightened ("diluted") to gray or light brown, and may lighten red pigment to cream. This affects their fur, skin, and sometimes eye color. The D locus result that we report is determined by two different genetic variants that can work together to cause diluted pigmentation. These are the common **d** allele, also known as "**d1**", and a less common allele known as "**d2**". Dogs with one **d1** allele and one **d2** allele are typically dilute. To view your dog's **d1** and **d2** test results, click the "SEE DETAILS" link in the upper right hand corner of the "Base Coat Color" section of the Traits page, and then click the "VIEW SUBLOCUS RESULTS" link at the bottom of the page.

**Dark (non-dilute) skin**

**Did You Know?** There are many breed-specific names for these dilute colors, such as "blue", "charcoal", "fawn", "silver", and "Isabella". Dilute dogs, especially in certain breeds, have a higher incidence of Color Dilution Alopecia which causes hair loss in some patches.



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## TRAITS: COAT COLOR MODIFIERS

### TRAIT

### RESULT

**Hidden Patterning** | *K (Dominant Black) Locus* | Gene: *Canine Beta-Defensin 103 (CBD103)* | Genetic Result: **K<sup>B</sup>K<sup>B</sup>**

This gene helps determine whether the dog has a black coat. Dogs with a **k<sup>Y</sup>k<sup>Y</sup>** result will show a coat color pattern based on the result they have at the A (Agouti) Locus. A **K<sup>B</sup>K<sup>B</sup>** or **K<sup>B</sup>k<sup>Y</sup>** result means the dog is dominant black, which overrides the fur pattern that would otherwise be determined by the A (Agouti) Locus. These dogs will usually have solid black or brown coats, or if they have **ee** at the E (Extension) Locus then red/cream coats, regardless of their result at the A (Agouti) Locus. Dogs who test as **K<sup>B</sup>k<sup>Y</sup>** may be brindle rather than black or brown.

**No impact on coat color**

**Did You Know?** Even if a dog is "dominant black" several other genes could still impact the dog's fur and cause other patterns, such as white spotting.

**Body Pattern** | *A (Agouti) Locus* | Gene: *Agouti Signalling Protein (ASIP)* | Genetic Result: **a<sup>t</sup>a<sup>t</sup>**

This gene is responsible for causing different coat patterns. It only affects the fur of dogs that do not have **ee** at the E (Extension) Locus and do have **k<sup>Y</sup>k<sup>Y</sup>** at the K (Dominant Black) Locus. It controls switching between black and red pigment in hair cells, which means that it can cause a dog to have hairs that have sections of black and sections of red/cream, or hairs with different colors on different parts of the dog's body. Sable or Fawn dogs have a mostly or entirely red coat with some interspersed black hairs. Agouti or Wolf Sable dogs have red hairs with black tips, mostly on their head and back. Black and tan dogs are mostly black or brown with lighter patches on their cheeks, eyebrows, chest, and legs. Recessive black dogs have solid-colored black or brown coats.

**No impact on coat pattern**

**Did You Know?** The ASIP gene causes interesting coat patterns in many other species of animals as well as dogs.

**Facial Fur Pattern** | *E (Extension) Locus* | Gene: *Melanocortin Receptor 1 (MC1R)* | Genetic Result: **ee**

In addition to determining if a dog can develop dark fur at all, this gene can give a dog a black "mask" or "widow's peak," unless the dog has overriding coat color genetic factors. Dogs with one or two copies of **E<sup>m</sup>** in their result will have a mask, which is dark facial fur as seen in the German Shepherd and Pug. Dogs with no **E<sup>m</sup>** in their result but one or two copies of **E<sup>9</sup>** will instead have a "widow's peak", which is dark forehead fur.

**No dark fur anywhere**

**Did You Know?** The widow's peak is seen in the Afghan Hound and Borzoi, where it is called either "grizzle" or "domino".



## TRAITS: COAT COLOR MODIFIERS (CONTINUED)

TRAIT

RESULT

**Saddle Tan** | Gene: *RALY* | Genetic Result: **NI**

The "Saddle Tan" pattern causes the black hairs to recede into a "saddle" shape on the back, leaving a tan face, legs, and belly, as a dog ages. The Saddle Tan pattern is characteristic of breeds like the Corgi, Beagle, and German Shepherd. Dogs that have the **II** genotype at this locus are more likely to be mostly black with tan points on the eyebrows, muzzle, and legs as commonly seen in the Doberman Pinscher and the Rottweiler. This gene modifies the A Locus **a<sup>t</sup>** allele, so dogs that do not express **a<sup>t</sup>** are not influenced by this gene.

**No impact on coat pattern**

**Did You Know?** The Saddle Tan pattern is characteristic of breeds like the Corgi, Beagle, and German Shepherd.

**White Spotting** | S (*White Spotting*) Locus | Gene: *MITF* | Genetic Result: **SS**

This gene is responsible for most of the white spotting observed in dogs. Dogs with a result of **spsp** will have a nearly white coat or large patches of white in their coat. Dogs with a result of **Ssp** will have more limited white spotting that is breed-dependent. A result of **SS** means that a dog likely has no white or minimal white in their coat. The S Locus does not explain all white spotting patterns in dogs and other causes are currently being researched. Some dogs may have small amounts of white on the paws, chest, face, or tail regardless of their result at this gene.

**Likely to have little to no white in coat**

**Did You Know?** Any dog can have white spotting regardless of coat color. The colored sections of the coat will reflect the dog's other genetic coat color results.

**Merle** | M (*Merle*) Locus | Gene: *PMEL* | Genetic Result: **mm**

This gene is responsible for mottled or patchy coat color in some dogs. Dogs with an **M\*m** result are likely to have merle coat patterning or be "phantom" merle (where the merle allele is not obvious in their coat). Dogs with an **M\*M\*** result are likely to have merle or double merle coat patterning. Dogs with an **mm** result are unlikely to have a merle coat pattern.

**No impact on coat color**

**Did You Know?** Merle coat patterning is common to several dog breeds including the Australian Shepherd, Catahoula Leopard Dog, and Shetland Sheepdog.





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## TRAITS: COAT COLOR MODIFIERS (CONTINUED)

### TRAIT

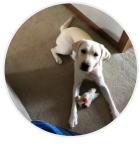
### RESULT

**Harlequin** | Gene: *PSMB* | Genetic Result: **hh**

This gene, along with the M Locus, determines whether a dog will have harlequin patterning. This pattern is recognized in Great Danes and causes dogs to have a white coat with patches of darker pigment. A dog with an **Hh** result will be harlequin if they are also **M\*m** or **M\*M\*** at the M Locus and are not **ee** at the E locus. Dogs with a result of **hh** will not be harlequin.

**No impact on coat pattern**

**Did You Know?** While many harlequin dogs are white with black patches, some dogs have grey, sable, or brindle patches of color, depending on their genotypes at other coat color genes.



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## TRAITS: OTHER COAT TRAITS

**TRAIT** **RESULT**

### **Furnishings LINKAGE** | Gene: *RSP02* | Genetic Result: **II**

This gene is responsible for "furnishings", which is another name for the mustache, beard, and eyebrows that are characteristic of breeds like the Schnauzer, Scottish Terrier, and Wire Haired Dachshund. A dog with an **FF** or **FI** result is likely to have furnishings. A dog with an **II** result will not have furnishings. We measure this result using a linkage test.

**Likely unfurnished (no mustache, beard, and/or eyebrows)**

**Did You Know?** In breeds that are expected to have furnishings, dogs without furnishings are the exception - this is sometimes called an "improper coat".

### **Coat Length** | Gene: *FGF5* | Genetic Result: **GG**

This gene is known to affect hair/fur length in many different species, including cats, dogs, mice, and humans. In dogs, a **TT** result means the dog is likely to have a long, silky coat as seen in the Yorkshire Terrier and the Long Haired Whippet. A **GG** or **GT** result is likely to mean a shorter coat, like in the Boxer or the American Staffordshire Terrier.

**Likely short or mid-length coat**

**Did You Know?** In certain breeds, such as Corgi, the long coat is described as "fluff."

### **Shedding** | Gene: *MC5R* | Genetic Result: **CT**

This gene affects how much a dog sheds. Dogs with furnishings or wire-haired coats tend to be low shedders regardless of their result for this gene. In other dogs, a **CC** or **CT** result indicates heavy or seasonal shedding, like many Labradors and German Shepherd Dogs. Dogs with a **TT** result tend to be lighter shedders, like Boxers, Shih Tzus and Chihuahuas.

**Likely heavy/seasonal shedding**

### **Coat Texture** | Gene: *KRT71* | Genetic Result: **CC**

For dogs with long fur, dogs with a **TT** or **CT** result will likely have a wavy or curly coat like the coat of Poodles and Bichon Frises. Dogs with a **CC** result will likely have a straight coat—unless the dog has a "Likely Furnished" result for the Furnishings trait, since this can also make the coat more curly.

**Likely straight coat**

**Did You Know?** Dogs with short coats may have straight coats, whatever result they have for this gene.



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## TRAITS: OTHER COAT TRAITS (CONTINUED)

<b>TRAIT</b>	<b>RESULT</b>
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**Hairlessness (Terrier type)** | Gene: *SGK3* | Genetic Result: **NN**

This gene is responsible for Hairlessness in the American Hairless Terrier. Dogs with the **ND** result are likely to be hairless. Dogs with the **NN** result are likely to have a normal coat.

**Very unlikely to be hairless**

**Oculocutaneous Albinism Type 2 LINKAGE** | Gene: *SLC45A2* | Genetic Result: **NN**

This gene causes oculocutaneous albinism (OCA), also known as Doberman Z Factor Albinism. Dogs with a **DD** result will have OCA. Effects include severely reduced or absent pigment in the eyes, skin, and hair, and sometimes vision problems due to lack of eye pigment (which helps direct and absorb ambient light) and are prone to sunburn. Dogs with a **ND** result will not be affected, but can pass the mutation on to their offspring. We measure this result using a linkage test.

**Likely not albino**

**Did You Know?** This particular mutation can be traced back to a single white Doberman Pinscher born in 1976, and it has only been observed in dogs descended from this individual.



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## TRAITS: OTHER BODY FEATURES

**TRAIT** **RESULT**

**Muzzle Length** | Gene: *BMP3* | Genetic Result: **CC**

This gene affects muzzle length. A dog with a **AC** or **CC** result is likely to have a medium-length muzzle like a Staffordshire Terrier or Labrador, or a long muzzle like a Whippet or Collie. A dog with a **AA** result is likely to have a short muzzle, like an English Bulldog, Pug, or Pekingese.

**Likely medium or long muzzle**

**Did You Know?** At least five different genes affect snout length in dogs, with *BMP3* being the only one with a known causal mutation. For example, the muzzle length of some breeds, including the long-snouted Scottish Terrier or the short-snouted Japanese Chin, appear to be caused by other genes. This means your dog may have a long or short snout due to other genetic factors. Embark is working to figure out what these might be.

**Tail Length** | Gene: *T* | Genetic Result: **CC**

This is one of the genes that can cause a short bobtail. Most dogs have a **CC** result and a long tail. Dogs with a **CG** result are likely to have a bobtail, which is an unusually short or absent tail. This can be seen in many "natural bobtail" breeds including the Pembroke Welsh Corgi, the Australian Shepherd, and the Brittany Spaniel. Dogs with **GG** genotypes have not been observed, suggesting that dogs with such a result do not survive to birth.

**Likely normal-length tail**

**Did You Know?** While certain lineages of Boston Terrier, English Bulldog, Rottweiler, Miniature Schnauzer, Cavalier King Charles Spaniel, and Parson Russell Terrier, and Dobermans are born with a natural bobtail, it is not always caused by this gene. This suggests that other unknown genetic effects can also lead to a natural bobtail.

**Hind Dew Claws** | Gene: *LMBR1* | Genetic Result: **CC**

This is one of the genes that can cause hind dew claws, which are extra, nonfunctional digits located midway between a dog's paw and hock. Dogs with a **CT** or **TT** result have about a 50% chance of having hind dewclaws. Hind dew claws can also be caused by other, still unknown, genes. Embark is working to figure those out.

**Unlikely to have hind dew claws**

**Did You Know?** Hind dew claws are commonly found in certain breeds such as the Saint Bernard.



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## TRAITS: OTHER BODY FEATURES (CONTINUED)

<b>TRAIT</b>	<b>RESULT</b>
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**Back Muscling & Bulk (Large Breed)** | Gene: *ACSL4* | Genetic Result: **CC**

This gene can cause heavy muscling along the back and trunk in characteristically "bulky" large-breed dogs including the Saint Bernard, Bernese Mountain Dog, Greater Swiss Mountain Dog, and Rottweiler. A dog with the **TT** result is likely to have heavy muscling. Leaner-shaped large breed dogs like the Great Dane, Irish Wolfhound, and Scottish Deerhound generally have a **CC** result. The **TC** result also indicates likely normal muscling.

**Likely normal muscling**

**Did You Know?** This gene does not seem to affect muscling in small or even mid-sized dog breeds with lots of back muscling, including the American Staffordshire Terrier, Boston Terrier, and the English Bulldog.

**Eye Color LINKAGE** | Gene: *ALX4* | Genetic Result: **NN**

This gene is associated with blue eyes in Arctic breeds like Siberian Husky as well as tri-colored (non-merle) Australian Shepherds. Dogs with a **DupDup** or **NDup** result are more likely to have blue eyes, although some dogs may have only one blue eye or may not have blue eyes at all; nevertheless, they can still pass blue eyes to their offspring. Dogs with a **NN** result may have blue eyes due to other factors, such as merle or white spotting. We measure this result using a linkage test.

**Less likely to have blue eyes**

**Did You Know?** Embark researchers discovered this gene by studying data from dogs like yours. Who knows what we will be able to discover next? Answer the questions on our research surveys to contribute to future discoveries!



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## TRAITS: BODY SIZE

<b>TRAIT</b>	<b>RESULT</b>
--------------	---------------

**Body Size 1** | Gene: *IGF1* | Genetic Result: **NN**

This is one of several genes that influence the size of a dog. A result of **II** for this gene is associated with smaller body size. A result of **NN** is associated with larger body size.

**Larger**

**Body Size 2** | Gene: *IGFR1* | Genetic Result: **GG**

This is one of several genes that influence the size of a dog. A result of **AA** for this gene is associated with smaller body size. A result of **GG** is associated with larger body size.

**Larger**

**Body Size 3** | Gene: *STC2* | Genetic Result: **TT**

This is one of several genes that influence the size of a dog. A result of **AA** for this gene is associated with smaller body size. A result of **TT** is associated with larger body size.

**Larger**

**Body Size 4** | Gene: *GHR - E191K* | Genetic Result: **AA**

This is one of several genes that influence the size of a dog. A result of **AA** for this gene is associated with smaller body size. A result of **GG** is associated with larger body size.

**Smaller**

**Body Size 5** | Gene: *GHR - P177L* | Genetic Result: **CC**

This is one of several genes that influence the size of a dog. A result of **TT** for this gene is associated with smaller body size. A result of **CC** is associated with larger body size.

**Larger**



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## TRAITS: PERFORMANCE

TRAIT

RESULT

**Altitude Adaptation** | Gene: *EPAS1* | Genetic Result: **GG**

This gene causes dogs to be especially tolerant of low oxygen environments, such as those found at high elevations. Dogs with a **AA** or **GA** result will be less susceptible to "altitude sickness."

**Normal altitude tolerance**

**Did You Know?** This gene was originally identified in breeds from high altitude areas such as the Tibetan Mastiff.

**Appetite LINKAGE** | Gene: *POMC* | Genetic Result: **NN**

This gene influences eating behavior. An **ND** or **DD** result would predict higher food motivation compared to **NN** result, increasing the likelihood to eat excessively, have higher body fat percentage, and be more prone to obesity. Read more about the genetics of POMC, and learn how you can contribute to research, in our blog post (<https://embarkvet.com/resources/blog/pomc-dogs/>). We measure this result using a linkage test.

**Normal food motivation**

**Did You Know?** POMC is actually short for "proopiomelanocortin," and is a large protein that is broken up into several smaller proteins that have biological activity. The smaller proteins generated from POMC control, among other things, distribution of pigment to the hair and skin cells, appetite, and energy expenditure.



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## CLINICAL TOOLS

These clinical genetic tools can inform clinical decisions and diagnoses. These tools do not predict increased risk for disease.

### Alanine Aminotransferase Activity (GPT)

✔ JoJo's baseline ALT level is likely to be Normal

#### What is Alanine Aminotransferase Activity?

Alanine aminotransferase (ALT) is a clinical tool that can be used by veterinarians to better monitor liver health. This result is not associated with liver disease. ALT is one of several values veterinarians measure on routine blood work to evaluate the liver. It is a naturally occurring enzyme located in liver cells that helps break down protein. When the liver is damaged or inflamed, ALT is released into the bloodstream.

#### How vets diagnose this condition

Genetic testing is the only way to provide your veterinarian with this clinical tool.

#### How this condition is treated

Veterinarians may recommend blood work to establish a baseline ALT value for healthy dogs with one or two copies of this variant.





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## HEALTH REPORT

### How to interpret JoJo's genetic health results:

If JoJo inherited any of the variants that we tested, they will be listed at the top of the Health Report section, along with a description of how to interpret this result. We also include all of the variants that we tested JoJo for that we did not detect the risk variant for.

### A genetic test is not a diagnosis

This genetic test does not diagnose a disease. Please talk to your vet about your dog's genetic results, or if you think that your pet may have a health condition or disease.



### Good news!

JoJo is not at increased risk for the genetic health conditions that Embark tests.

**Breed-Relevant Genetic Conditions**

**16 variants not detected**



**Additional Genetic Conditions**

**167 variants not detected**





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## BREED-RELEVANT CONDITIONS TESTED



**JoJo did not have the variants that we tested for, that are relevant to her breed:**

- ✓ Canine Elliptocytosis (SPTB Exon 30)
- ✓ Pyruvate Kinase Deficiency (PKLR Exon 7, Labrador Retriever Variant)
- ✓ Progressive Retinal Atrophy, prcd (PRCD Exon 1)
- ✓ Golden Retriever Progressive Retinal Atrophy 2, GR-PRA2 (TTC8)
- ✓ Progressive Retinal Atrophy, crd4/cord1 (RPGRIP1)
- ✓ Achromatopsia (CNGA3 Exon 7, Labrador Retriever Variant)
- ✓ Macular Corneal Dystrophy, MCD (CHST6)
- ✓ Hyperuricosuria and Hyperuricemia or Urolithiasis, HUU (SLC2A9)
- ✓ Alexander Disease (GFAP)
- ✓ Narcolepsy (HCRTR2 Intron 6, Labrador Retriever Variant)
- ✓ Centronuclear Myopathy, CNM (PTPLA)
- ✓ Exercise-Induced Collapse, EIC (DNM1)
- ✓ Myotubular Myopathy 1, X-linked Myotubular Myopathy, XL-MTM (MTM1, Labrador Retriever Variant)
- ✓ Congenital Myasthenic Syndrome, CMS (COLQ, Labrador Retriever Variant)
- ✓ Hereditary Nasal Parakeratosis, HNPk (SUV39H2)
- ✓ Skeletal Dysplasia 2, SD2 (COL11A2, Labrador Retriever Variant)

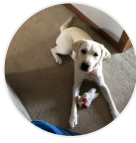


## ADDITIONAL CONDITIONS TESTED



JoJo did not have the variants that we tested for, in the following conditions that the potential effect on dogs with JoJo's breed may not yet be known.

- ✓ MDR1 Drug Sensitivity (ABCB1)
- ✓ P2Y12 Receptor Platelet Disorder (P2Y12)
- ✓ Factor IX Deficiency, Hemophilia B (F9 Exon 7, Terrier Variant)
- ✓ Factor IX Deficiency, Hemophilia B (F9 Exon 7, Rhodesian Ridgeback Variant)
- ✓ Factor VII Deficiency (F7 Exon 5)
- ✓ Factor VIII Deficiency, Hemophilia A (F8 Exon 10, Boxer Variant)
- ✓ Factor VIII Deficiency, Hemophilia A (F8 Exon 11, German Shepherd Variant 1)
- ✓ Factor VIII Deficiency, Hemophilia A (F8 Exon 1, German Shepherd Variant 2)
- ✓ Thrombopathia (RASGRP1 Exon 5, Basset Hound Variant)
- ✓ Thrombopathia (RASGRP1 Exon 8, Landseer Variant)
- ✓ Thrombopathia (RASGRP1 Exon 5, American Eskimo Dog Variant)
- ✓ Von Willebrand Disease Type III, Type III vWD (VWF Exon 4, Terrier Variant)
- ✓ Von Willebrand Disease Type III, Type III vWD (VWF Exon 7, Shetland Sheepdog Variant)
- ✓ Von Willebrand Disease Type I, Type I vWD (VWF)
- ✓ Von Willebrand Disease Type II, Type II vWD (VWF, Pointer Variant)
- ✓ Canine Leukocyte Adhesion Deficiency Type I, CLAD I (ITGB2, Setter Variant)
- ✓ Canine Leukocyte Adhesion Deficiency Type III, CLAD III (FERMT3, German Shepherd Variant)
- ✓ Congenital Macrothrombocytopenia (TUBB1 Exon 1, Cairn and Norfolk Terrier Variant)
- ✓ Glanzmann's Thrombasthenia Type I (ITGA2B Exon 12, Otterhound Variant)
- ✓ May-Hegglin Anomaly (MYH9)
- ✓ Prekallikrein Deficiency (KLKB1 Exon 8)
- ✓ Pyruvate Kinase Deficiency (PKLR Exon 5, Basenji Variant)
- ✓ Pyruvate Kinase Deficiency (PKLR Exon 7, Pug Variant)



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DNA Test Report

Test Date: April 20th, 2019

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## ADDITIONAL CONDITIONS TESTED

- ✓ Trapped Neutrophil Syndrome, TNS (VPS13B)
- ✓ Ligneous Membranitis, LM (PLG)
- ✓ Congenital Hypothyroidism (TPO, Tenterfield Terrier Variant)
- ✓ Complement 3 Deficiency, C3 Deficiency (C3)
- ✓ Severe Combined Immunodeficiency, SCID (PRKDC, Terrier Variant)
- ✓ Severe Combined Immunodeficiency, SCID (RAG1, Wetterhoun Variant)
- ✓ X-linked Severe Combined Immunodeficiency, X-SCID (IL2RG Exon 1, Basset Hound Variant)
- ✓ X-linked Severe Combined Immunodeficiency, X-SCID (IL2RG, Corgi Variant)
- ✓ Progressive Retinal Atrophy, rcd1 (PDE6B Exon 21, Irish Setter Variant)
- ✓ Progressive Retinal Atrophy, rcd3 (PDE6A)
- ✓ Progressive Retinal Atrophy, CNGA (CNGA1 Exon 9)
- ✓ Progressive Retinal Atrophy, PRA1 (CNGB1)
- ✓ Progressive Retinal Atrophy (SAG)
- ✓ Golden Retriever Progressive Retinal Atrophy 1, GR-PRA1 (SLC4A3)
- ✓ Progressive Retinal Atrophy, crd1 (PDE6B, American Staffordshire Terrier Variant)
- ✓ Progressive Retinal Atrophy, crd2 (IQCB1)
- ✓ X-Linked Progressive Retinal Atrophy 1, XL-PRA1 (RPGR)
- ✓ Progressive Retinal Atrophy, PRA3 (FAM161A)
- ✓ Collie Eye Anomaly, Choroidal Hypoplasia, CEA (NHEJ1)
- ✓ Day Blindness, Cone Degeneration, Achromatopsia (CNGB3 Exon 6, German Shorthaired Pointer Variant)
- ✓ Achromatopsia (CNGA3 Exon 7, German Shepherd Variant)
- ✓ Autosomal Dominant Progressive Retinal Atrophy (RHO)
- ✓ Canine Multifocal Retinopathy, cmr1 (BEST1 Exon 2)
- ✓ Canine Multifocal Retinopathy, cmr2 (BEST1 Exon 5, Coton de Tulear Variant)
- ✓ Canine Multifocal Retinopathy, cmr3 (BEST1 Exon 10 Deletion, Finnish and Swedish Lapphund, Lapponian Herder Variant)

Registration: AKC SS06553201



Microchip: 985112011308309



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DNA Test Report

Test Date: April 20th, 2019

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## ADDITIONAL CONDITIONS TESTED

- ✓ Primary Open Angle Glaucoma (ADAMTS10 Exon 9, Norwegian Elkhound Variant)
- ✓ Primary Open Angle Glaucoma (ADAMTS10 Exon 17, Beagle Variant)
- ✓ Primary Open Angle Glaucoma (ADAMTS17 Exon 11, Basset Fauve de Bretagne Variant)
- ✓ Primary Open Angle Glaucoma and Primary Lens Luxation (ADAMTS17 Exon 2, Chinese Shar-Pei Variant)
- ✓ Hereditary Cataracts, Early-Onset Cataracts, Juvenile Cataracts (HSF4 Exon 9, Australian Shepherd Variant)
- ✓ Primary Lens Luxation (ADAMTS17)
- ✓ Congenital Stationary Night Blindness (RPE65, Briard Variant)
- ✓ 2,8-Dihydroxyadenine Urolithiasis, 2,8-DHA Urolithiasis (APRT)
- ✓ Cystinuria Type I-A (SLC3A1, Newfoundland Variant)
- ✓ Cystinuria Type II-A (SLC3A1, Australian Cattle Dog Variant)
- ✓ Cystinuria Type II-B (SLC7A9, Miniature Pinscher Variant)
- ✓ Polycystic Kidney Disease, PKD (PKD1)
- ✓ Primary Hyperoxaluria (AGXT)
- ✓ Protein Losing Nephropathy, PLN (NPHS1)
- ✓ X-Linked Hereditary Nephropathy, XLHN (COL4A5 Exon 35, Samoyed Variant 2)
- ✓ Autosomal Recessive Hereditary Nephropathy, Familial Nephropathy, ARHN (COL4A4 Exon 3, Cocker Spaniel Variant)
- ✓ Primary Ciliary Dyskinesia, PCD (CCDC39 Exon 3, Old English Sheepdog Variant)
- ✓ Congenital Keratoconjunctivitis Sicca and Ichthyosiform Dermatitis, Dry Eye Curly Coat Syndrome, CKCSID (FAM83H Exon 5)
- ✓ X-linked Ectodermal Dysplasia, Anhidrotic Ectodermal Dysplasia, XHED (EDA Intron 8)
- ✓ Renal Cystadenocarcinoma and Nodular Dermatofibrosis, RCND (FLCN Exon 7)
- ✓ Canine Fucosidosis (FUCA1)
- ✓ Glycogen Storage Disease Type II, Pompe's Disease, GSD II (GAA, Finnish and Swedish Lapphund, Lapponian Herder Variant)
- ✓ Glycogen Storage Disease Type IA, Von Gierke Disease, GSD IA (G6PC, Maltese Variant)
- ✓ Glycogen Storage Disease Type IIIA, GSD IIIA (AGL, Curly Coated Retriever Variant)
- ✓ Mucopolysaccharidosis Type I, MPS I (IDUA, Plott Hound Variant)

Registration: AKC SS06553201



Microchip: 985112011308309



## ADDITIONAL CONDITIONS TESTED

- ✓ Mucopolysaccharidosis Type IIIA, Sanfilippo Syndrome Type A, MPS IIIA (SGSH Exon 6, Dachshund Variant)
- ✓ Mucopolysaccharidosis Type IIIA, Sanfilippo Syndrome Type A, MPS IIIA (SGSH Exon 6, New Zealand Huntaway Variant)
- ✓ Mucopolysaccharidosis Type VII, Sly Syndrome, MPS VII (GUSB Exon 5, Terrier Brasileiro Variant)
- ✓ Mucopolysaccharidosis Type VII, Sly Syndrome, MPS VII (GUSB Exon 3, German Shepherd Variant)
- ✓ Glycogen storage disease Type VII, Phosphofructokinase Deficiency, PFK Deficiency (PFKM, Whippet and English Springer Spaniel Variant)
- ✓ Glycogen storage disease Type VII, Phosphofructokinase Deficiency, PFK Deficiency (PFKM, Wachtelhund Variant)
- ✓ Lagotto Storage Disease (ATG4D)
- ✓ Neuronal Ceroid Lipofuscinosis 1, NCL 1 (PPT1 Exon 8, Dachshund Variant 1)
- ✓ Neuronal Ceroid Lipofuscinosis 2, NCL 2 (TPP1 Exon 4, Dachshund Variant 2)
- ✓ Neuronal Ceroid Lipofuscinosis, Cerebellar Ataxia, NCL4A (ARSG Exon 2, American Staffordshire Terrier Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 5, NCL 5 (CLN5 Exon 4 SNP, Border Collie Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 6, NCL 6 (CLN6 Exon 7, Australian Shepherd Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 8, NCL 8 (CLN8 Exon 2, English Setter Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 7, NCL 7 (MFSD8, Chihuahua and Chinese Crested Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 8, NCL 8 (CLN8, Australian Shepherd Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 10, NCL 10 (CTSD Exon 5, American Bulldog Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 5, NCL 5 (CLN5 Exon 4 Deletion, Golden Retriever Variant)
- ✓ Adult-Onset Neuronal Ceroid Lipofuscinosis, NCL A, NCL 12 (ATP13A2, Tibetan Terrier Variant)
- ✓ GM1 Gangliosidosis (GLB1 Exon 15, Shiba Inu Variant)
- ✓ GM1 Gangliosidosis (GLB1 Exon 15, Alaskan Husky Variant)
- ✓ GM1 Gangliosidosis (GLB1 Exon 2, Portuguese Water Dog Variant)
- ✓ GM2 Gangliosidosis (HEXB, Poodle Variant)
- ✓ GM2 Gangliosidosis (HEXA, Japanese Chin Variant)
- ✓ Globoid Cell Leukodystrophy, Krabbe disease (GALC Exon 5, Terrier Variant)
- ✓ Autosomal Recessive Amelogenesis Imperfecta, Familial Enamel Hypoplasia (ENAM Deletion, Italian Greyhound Variant)



## ADDITIONAL CONDITIONS TESTED

- ✓ Persistent Mullerian Duct Syndrome, PMDS (AMHR2)
- ✓ Deafness and Vestibular Syndrome of Dobermans, DVDob, DINGS (MY07A)
- ✓ Shar-Pei Autoinflammatory Disease, SPAID, Shar-Pei Fever (MTBP)
- ✓ Alaskan Husky Encephalopathy, Subacute Necrotizing Encephalomyelopathy (SLC19A3)
- ✓ Cerebellar Abiotrophy, Neonatal Cerebellar Cortical Degeneration, NCCD (SPTBN2, Beagle Variant)
- ✓ Cerebellar Ataxia, Progressive Early-Onset Cerebellar Ataxia (SEL1L, Finnish Hound Variant)
- ✓ Cerebellar Hypoplasia (VLDLR, Eurasier Variant)
- ✓ Spinocerebellar Ataxia, Late-Onset Ataxia, LoSCA (CAPN1)
- ✓ Spinocerebellar Ataxia with Myokymia and/or Seizures (KCNJ10)
- ✓ Hereditary Ataxia, Cerebellar Degeneration (RAB24, Old English Sheepdog and Gordon Setter Variant)
- ✓ Benign Familial Juvenile Epilepsy, Remitting Focal Epilepsy (LGI2)
- ✓ Degenerative Myelopathy, DM (SOD1A)
- ✓ Fetal-Onset Neonatal Neuroaxonal Dystrophy (MFN2, Giant Schnauzer Variant)
- ✓ Hypomyelination and Tremors (FNIP2, Weimaraner Variant)
- ✓ Shaking Puppy Syndrome, X-linked Generalized Tremor Syndrome (PLP1, English Springer Spaniel Variant)
- ✓ Neuroaxonal Dystrophy, NAD (TECPR2, Spanish Water Dog Variant)
- ✓ L-2-Hydroxyglutaricaciduria, L2HGA (L2HGDH, Staffordshire Bull Terrier Variant)
- ✓ Neonatal Encephalopathy with Seizures, NEWS (ATF2)
- ✓ Polyneuropathy (NDRG1 Deletion, Greyhound Variant)
- ✓ Alaskan Malamute Polyneuropathy, AMPN (NDRG1 SNP)
- ✓ Narcolepsy (HCRTR2 Exon 1, Dachshund Variant)
- ✓ Progressive Neuronal Abiotrophy, Canine Multiple System Degeneration, CMSD (SERAC1 Exon 15, Kerry Blue Terrier Variant)
- ✓ Progressive Neuronal Abiotrophy, Canine Multiple System Degeneration, CMSD (SERAC1 Exon 4, Chinese Crested Variant)
- ✓ Juvenile Laryngeal Paralysis and Polyneuropathy, Polyneuropathy with Ocular Abnormalities and Neuronal Vacuolation, POANV (RAB3GAP1, Rottweiler Variant)
- ✓ Hereditary Sensory Autonomic Neuropathy, Acral Mutilation Syndrome, AMS (GDNF-AS, Spaniel and Pointer Variant)



## ADDITIONAL CONDITIONS TESTED

- ✓ Juvenile-Onset Polyneuropathy, Leonberger Polyneuropathy 1, LPN1 (LPN1, ARHGEF10)
- ✓ Juvenile Myoclonic Epilepsy (DIRAS1)
- ✓ Juvenile-Onset Polyneuropathy, Leonberger Polyneuropathy 2, LPN2 (GJA9)
- ✓ Spongy Degeneration with Cerebellar Ataxia 1, SDCA1, SeSAME/EAST Syndrome (KCNJ10)
- ✓ Spongy Degeneration with Cerebellar Ataxia 2, SDCA2 (ATP1B2)
- ✓ Dilated Cardiomyopathy, DCM1 (PDK4, Doberman Pinscher Variant 1)
- ✓ Dilated Cardiomyopathy, DCM2 (TTN, Doberman Pinscher Variant 2)
- ✓ Long QT Syndrome (KCNQ1)
- ✓ Muscular Dystrophy (DMD, Cavalier King Charles Spaniel Variant 1)
- ✓ Muscular Dystrophy (DMD, Golden Retriever Variant)
- ✓ Limb Girdle Muscular Dystrophy (SGCD, Boston Terrier Variant)
- ✓ Inherited Myopathy of Great Danes (BIN1)
- ✓ Myostatin Deficiency, Bully Whippet Syndrome (MSTN)
- ✓ Myotonia Congenita (CLCN1 Exon 7, Miniature Schnauzer Variant)
- ✓ Myotonia Congenita (CLCN1 Exon 23, Australian Cattle Dog Variant)
- ✓ Hypocatalasia, Acatalasemia (CAT)
- ✓ Pyruvate Dehydrogenase Deficiency (PDP1, Spaniel Variant)
- ✓ Malignant Hyperthermia (RYR1)
- ✓ Imerslund-Grasbeck Syndrome, Selective Cobalamin Malabsorption (CUBN Exon 53, Border Collie Variant)
- ✓ Imerslund-Grasbeck Syndrome, Selective Cobalamin Malabsorption (CUBN Exon 8, Beagle Variant)
- ✓ Congenital Myasthenic Syndrome, CMS (CHAT, Old Danish Pointing Dog Variant)
- ✓ Episodic Falling Syndrome (BCAN)
- ✓ Paroxysmal Dyskinesia, PxD (PIGN)
- ✓ Dystrophic Epidermolysis Bullosa (COL7A1, Golden Retriever Variant)
- ✓ Ectodermal Dysplasia, Skin Fragility Syndrome (PKP1, Chesapeake Bay Retriever Variant)





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DNA Test Report

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## ADDITIONAL CONDITIONS TESTED

- ✓ Ichthyosis, Epidermolytic Hyperkeratosis (KRT10, Terrier Variant)
- ✓ Ichthyosis, ICH1 (PNPLA1, Golden Retriever Variant)
- ✓ Ichthyosis (SLC27A4, Great Dane Variant)
- ✓ Ichthyosis (NIPAL4, American Bulldog Variant)
- ✓ Focal Non-Epidermolytic Palmoplantar Keratoderma, Pachyonychia Congenita (KRT16, Dogue de Bordeaux Variant)
- ✓ Hereditary Footpad Hyperkeratosis (FAM83G, Terrier and Kromfohrlander Variant)
- ✓ Musladin-Lueke Syndrome, MLS (ADAMTSL2)
- ✓ Oculocutaneous Albinism, OCA (SLC45A2, Pekingese Variant)
- ✓ Cleft Lip and/or Cleft Palate (ADAMTS20, Nova Scotia Duck Tolling Retriever Variant)
- ✓ Hereditary Vitamin D-Resistant Rickets (VDR)
- ✓ Osteogenesis Imperfecta, Brittle Bone Disease (COL1A2, Beagle Variant)
- ✓ Osteogenesis Imperfecta, Brittle Bone Disease (SERPINH1, Dachshund Variant)
- ✓ Osteogenesis Imperfecta, Brittle Bone Disease (COL1A1, Golden Retriever Variant)
- ✓ Osteochondrodysplasia, Skeletal Dwarfism (SLC13A1, Poodle Variant)
- ✓ Craniomandibular Osteopathy, CMO (SLC37A2)
- ✓ Chondrodystrophy and Intervertebral Disc Disease, CDDY/IVDD, Type I IVDD (FGF4 retrogene - CFA12)
- ✓ Chondrodystrophy (ITGA10, Norwegian Elkhound and Karelian Bear Dog Variant)



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DNA Test Report

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## INBREEDING AND DIVERSITY

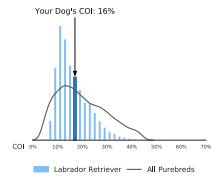
### CATEGORY

### RESULT

**Inbreeding** | Gene: *n/a* | Genetic Result: **16%**

**16%**

Inbreeding is a measure of how closely related this dog's parents were. The higher the number, the more closely related the parents. In general, greater inbreeding is associated with increased incidence of genetically inherited conditions.

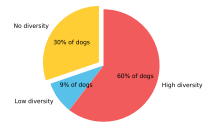


**Immune Response 1** | Gene: *DRB1* | Genetic Result: **No Diversity**

**No Diversity**

Diversity in the Major Histocompatibility Complex (MHC) region of the genome has been found in some studies to be associated with the incidence of certain autoimmune diseases. Dogs that have less diversity in the MHC region—i.e. the Dog Leukocyte Antigen (DLA) inherited from the mother is similar to the DLA inherited from the father—are considered less immunologically diverse. A High Diversity result means the dog has two highly dissimilar haplotypes. A Low Diversity result means the dog has two similar but not identical haplotypes. A No Diversity result means the dog has inherited identical haplotypes from both parents. Some studies have shown associations between certain DRB1 haplotypes and autoimmune diseases such as Cushing's disease, but these findings have yet to be scientifically validated.

How common is this amount of diversity in purebreds:



**Immune Response 2** | Gene: *DQA1 and DQB1* | Genetic Result: **Low Diversity**

**Low Diversity**

Diversity in the Major Histocompatibility Complex (MHC) region of the genome has been found in some studies to be associated with the incidence of certain autoimmune diseases. Dogs that have less diversity in the MHC region—i.e. the Dog Leukocyte Antigen (DLA) inherited from the mother is similar to the DLA inherited from the father—are considered less immunologically diverse. A High Diversity result means the dog has two highly dissimilar haplotypes. A Low Diversity result means the dog has two similar but not identical haplotypes. A No Diversity result means the dog has inherited identical haplotypes from both parents. A number of studies have shown correlations of DQA-DQB1 haplotypes and certain autoimmune diseases; however, these have not yet been scientifically validated.

How common is this amount of diversity in purebreds:

