

## BREED MIX



## GENETIC STATS

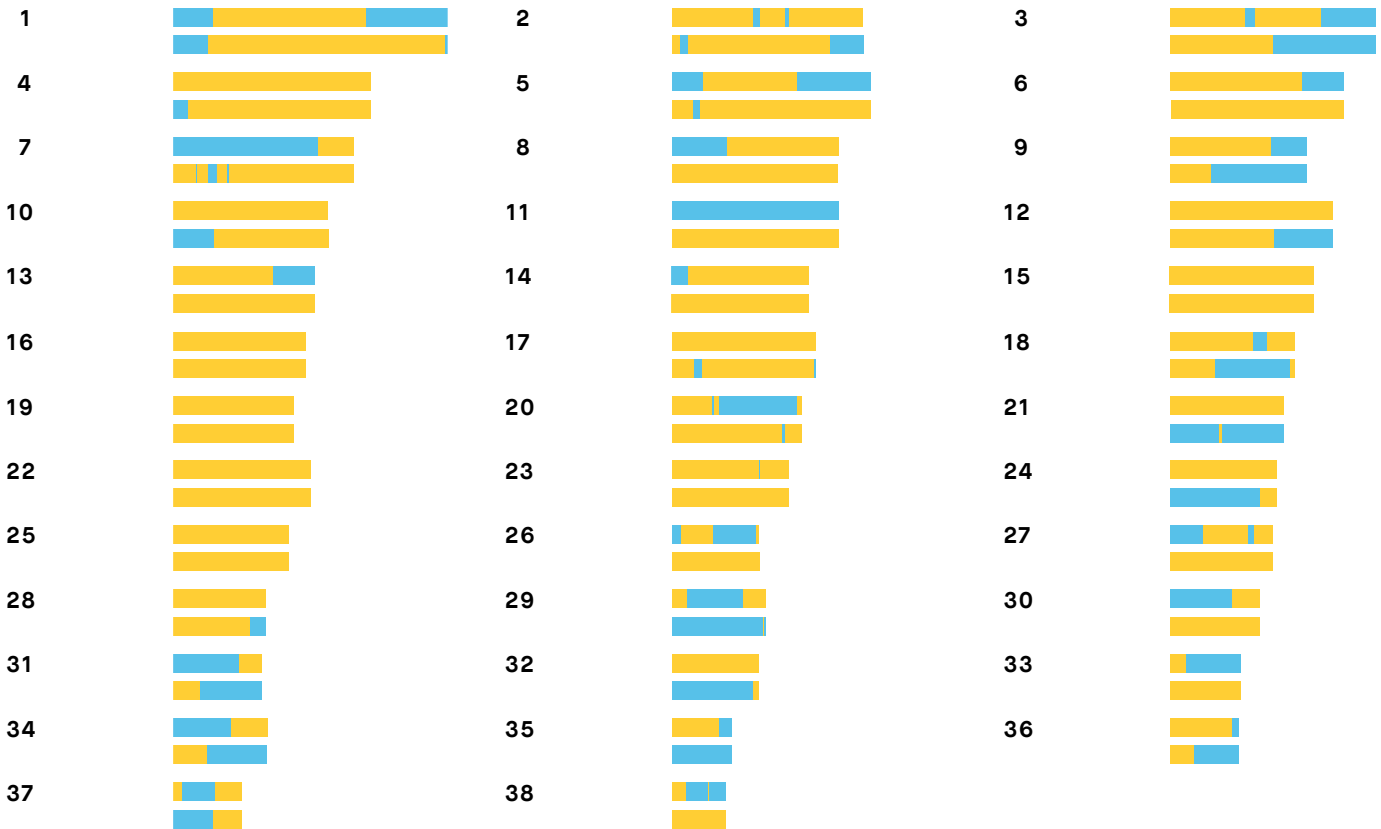
Wolfiness: 0.6 % **LOW**  
Predicted adult weight: **46 lbs**  
Genetic age: **8 human years**  
Based on the date of birth you provided

## TEST DETAILS

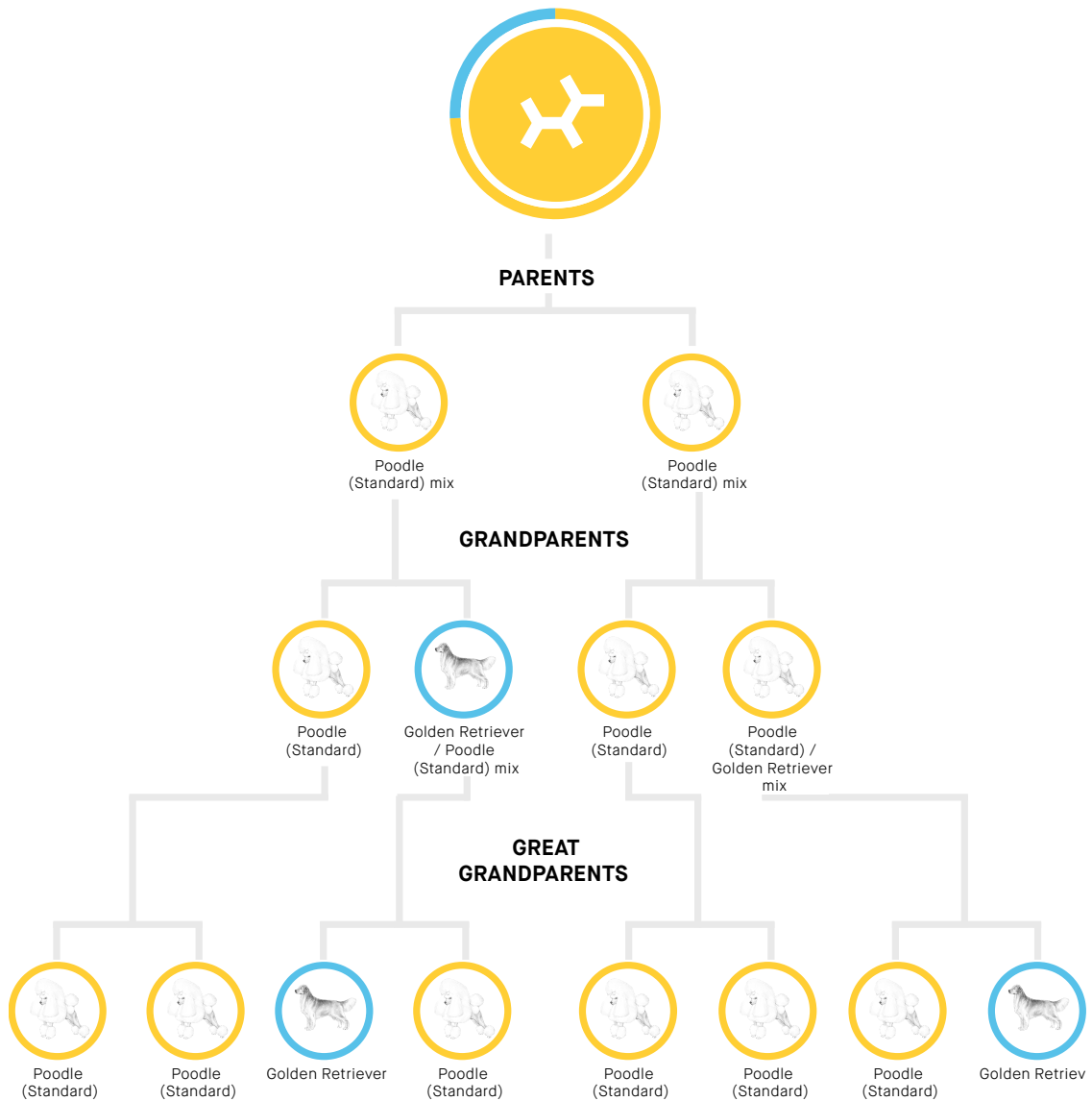
Kit number: EM-3645468  
Swab number: 31001809155921

## BREED MIX BY CHROMOSOME

Our advanced test identifies from where Piper Doodle inherited every part of the chromosome pairs in her genome.



## FAMILY TREE



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

## POODLE (STANDARD)



The Standard Poodle is a popular, water-loving dog used for centuries as a bird dog and popular pet. Poodles were established in Germany by the 15th century. Oddly enough, they are the national dog breed of France, and they were the most popular breed of dog in the United States throughout the 1960s and 70s. They're still quite popular today, owing to their intelligence, trainability, and non-shedding coats. Although well-known for their fancy fur, they're one of the most intelligent breeds of dog and require a lot of exercise and stimulation.

### Fun Fact

From 1989 to 1991, John Suter raced a team of Poodles in the Iditarod. Although his teams placed in the back half of the pack, he managed to win \$2,000 in prize money before retiring his poodle team. The Iditarod has since changed its rules to specify that only northern dog breeds can compete.

### RELATED BREEDS



**Poodle (Toy)**  
Sibling breed



**Poodle (Miniature)**  
Sibling breed



**Maltese**  
Cousin breed

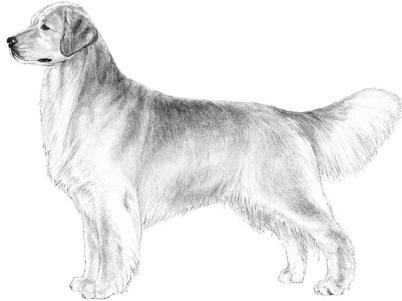


**Havanese**  
Cousin breed



**Bichon Frise**  
Cousin breed

## GOLDEN RETRIEVER



### Fun Fact

A Golden Retriever is also pictured in the Guinness Book of World's Records for "Most tennis balls held in mouth" (with 15).

The Golden Retriever was developed in the early 19th century as an ideal hunting companion, able to retrieve birds on both land and water in the marshy Scottish countryside. Their friendliness and intelligence makes the both a popular family pet and an excellent working dog, well suited for being a service dog, therapy dog or for search and rescue. The third most popular breed in the US, the American and Canadian Goldens are generally lankier and darker than their British counterparts. Their wavy, feathered topcoat is water resistant, their undercoat helps them with thermoregulation and both coats have a tendency for heavy seasonal shedding. Goldens need lots of exercise (especially when younger), and their love of play and water means their owners usually get a lot of exercise too! In 2013, the 100th anniversary of Britain's Golden Retriever Club, Goldens from around the world came made the pilgrimage to the breed's birthplace in Scotland, where 222 of them posed in a single record-breaking photo. At the same time, the Golden Retriever Lifetime Study was getting started in the United States, recruiting 3,000 Golden Retrievers for a lifetime study aimed at understanding how genetics, lifestyle and environment influences healthy aging and cancer risk in Goldens.

## RELATED BREEDS



**Flat-Coated Retriever**  
Sibling breed



**Labrador Retriever**  
Sibling breed

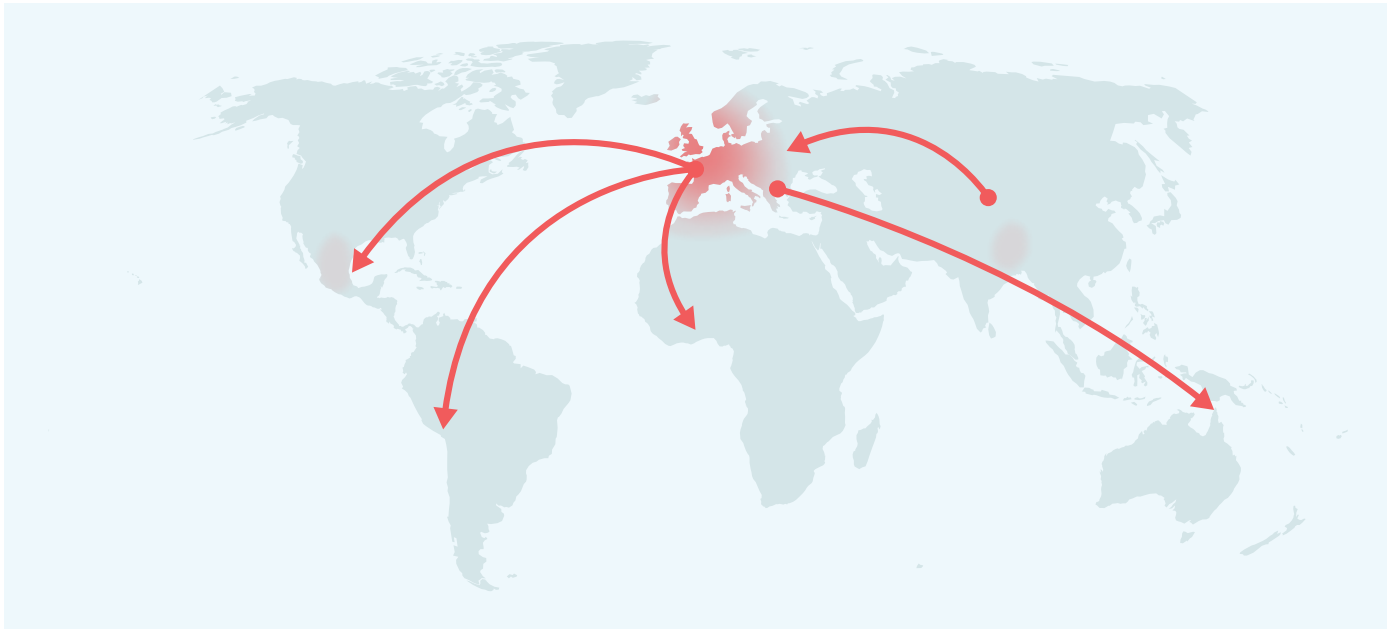


**Chesapeake Bay Retriever**  
Cousin breed



**Newfoundland**  
Cousin breed

## MATERNAL LINE



Through Piper Doodle'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: B1

B1 is the second most common maternal lineage in breeds of European or American origin. It is the female line of the majority of Golden Retrievers, Basset Hounds, and Shih Tzus, and about half of Beagles, Pekingese and Toy Poodles. This lineage is also somewhat common among village dogs that carry distinct ancestry from these breeds. We know this is a result of B1 dogs being common amongst the European dogs that their conquering owners brought around the world, because nowhere on earth is it a very common lineage in village dogs. It even enables us to trace the path of (human) colonization: Because most Bichons are B1 and Bichons are popular in Spanish culture, B1 is now fairly common among village dogs in Latin America.

### HAPLOTYPE: B84

Part of the large B1 haplogroup, this haplotype occurs most frequently in Golden Retrievers, Beagles, and Staffordshire Terriers.

## TRAITS: BASE COAT COLOR

TRAIT	RESULT
<p><b>Dark or Light Fur</b>   <i>E (Extension) Locus</i>   Gene: <i>Melanocortin Receptor 1 (MC1R)</i>   Genetic Result: <b>ee</b></p> <p>This gene helps determine whether a dog can produce dark (black or brown) hairs or lighter yellow or red hairs. Any result except for <b>ee</b> means that the dog can produce dark hairs. An <b>ee</b> result means that the dog does not produce dark hairs at all, and will have lighter yellow or red hairs over their entire body.</p> <p><b>Did You Know?</b> If a dog has a <b>ee</b> 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.</p>	<p><b>Light colored fur (cream to red)</b></p>
<p><b>Brown or Black Pigment</b>   <i>B (Brown) Locus</i>   Gene: <i>Tyrosinase Related Protein 1 (TYRP1)</i>   Genetic Result: <b>BB</b></p> <p>This gene helps determine whether a dog produces brown or black pigments. Dogs with a <b>bb</b> result produce brown pigment instead of black in both their hair and skin, while dogs with a <b>Bb</b> or <b>BB</b> result produce black pigment. Dogs that have <b>ee</b> at the E (Extension) Locus and <b>bb</b> 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.</p> <p><b>Did You Know?</b> "Liver" or "chocolate" is the preferred color term for brown in most breeds; in the Doberman Pinscher it is referred to as "red".</p>	<p><b>Likely black colored nose/feet</b></p>
<p><b>Color Dilution</b>   <i>D (Dilute) Locus</i>   Gene: <i>Melanophilin (MLPH)</i>   Genetic Result: <b>DD</b></p> <p>This gene helps determine whether a dog has lighter "diluted" pigment. A dog with a <b>Dd</b> or <b>DD</b> result will not be dilute. A dog with a <b>dd</b> result will have all their black or brown pigment lightened ("diluted") to gray or light brown, and sometimes lightens red pigment to cream. This affects their fur, skin, and sometimes eye color.</p> <p><b>Did You Know?</b> 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.</p>	<p><b>Dark (non-dilute) skin</b></p>

## TRAITS: COAT COLOR MODIFIERS

TRAIT	RESULT
<p><b>Hidden Patterning</b>   <i>K (Dominant Black) Locus</i>   <i>Gene: Canine Beta-Defensin 103 (CBD103)</i>   Genetic Result: <b>K<sup>B</sup>K<sup>B</sup></b></p> <p>This gene helps determine whether the dog has a black coat. Dogs with a <b>k<sup>Y</sup>k<sup>Y</sup></b> result will show a coat color pattern based on the result they have at the A (Agouti) Locus. A <b>K<sup>B</sup>K<sup>B</sup></b> or <b>K<sup>B</sup>k<sup>Y</sup></b> 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 <b>ee</b> at the E (Extension) Locus then red/cream coats, regardless of their result at the A (Agouti) Locus. Dogs who test as <b>K<sup>B</sup>k<sup>Y</sup></b> may be brindle rather than black or brown.</p> <p><b>Did You Know?</b> 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.</p>	<p><b>No impact on coat color</b></p>
<p><b>Body Pattern</b>   <i>A (Agouti) Locus</i>   <i>Gene: Agouti Signalling Protein (ASIP)</i>   Genetic Result: <b>a<sup>+</sup>a<sup>+</sup></b></p> <p>This gene is responsible for causing different coat patterns. It only affects the fur of dogs that do not have <b>ee</b> at the E (Extension) Locus and do have <b>k<sup>Y</sup>k<sup>Y</sup></b> 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.</p> <p><b>Did You Know?</b> The ASIP gene causes interesting coat patterns in many other species of animals as well as dogs.</p>	<p><b>No impact on coat pattern</b></p>
<p><b>Facial Fur Pattern</b>   <i>E (Extension) Locus</i>   <i>Gene: Melanocortin Receptor 1 (MC1R)</i>   Genetic Result: <b>ee</b></p> <p>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 <b>E<sup>m</sup></b> in their result will have a mask, which is dark facial fur as seen in the German Shepherd and Pug. Dogs with no <b>E<sup>m</sup></b> in their result but one or two copies of <b>E<sup>g</sup></b> will instead have a "widow's peak", which is dark forehead fur.</p> <p><b>Did You Know?</b> The widow's peak is seen in the Afghan Hound and Borzoi, where it is called either "grizzle" or "domino".</p>	<p><b>No dark fur anywhere</b></p>

## TRAITS: COAT COLOR MODIFIERS (CONTINUED)

TRAIT	RESULT
<p><b>Saddle Tan</b>   Gene: <i>RALY</i>   Genetic Result: <b>NI</b></p> <p>The <i>RALY</i> gene is responsible for the Saddle Tan coat pattern, where a dog's black hairs recede into a "saddle" shape on the back as the dog ages, leaving a tan face, legs, and belly. This gene only impacts dogs that have <b>a<sup>t</sup>a<sup>t</sup></b> at the A (Agouti) Locus, do not have <b>ee</b> at the E (Extension) Locus, and do not have <b>K<sup>B</sup></b> at the K (Dominant Black) Locus. Dogs with one or two copies of the normal "N" allele are likely to have a saddle tan pattern. Dogs that with a <b>II</b> result (where "I" represents the mutant allele) 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.</p>	<p><b>No impact on coat pattern</b></p>

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

<p><b>Merle</b>   <i>M (Merle) Locus</i>   Gene: <i>PMEL</i>   Genetic Result: <b>mm</b></p> <p>This gene is responsible for mottled or patchy coat color in some dogs. Dogs with an <b>M*m</b> 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 <b>M*M*</b> result are likely to have merle or double merle coat patterning. Dogs with an <b>mm</b> result are unlikely to have a merle coat pattern.</p>	<p><b>No impact on coat color</b></p>
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**Did You Know?** Merle coat patterning is common to several dog breeds including the Australian Shepherd, Catahoula Leopard Dog, and Shetland Sheepdog.



## TRAITS: OTHER COAT TRAITS

TRAIT	RESULT
<p><b>Furnishings LINKAGE</b>   <i>Gene: RSPO2</i>   Genetic Result: <b>FF</b></p> <p>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 <b>FF</b> or <b>FI</b> result is likely to have furnishings. A dog with an <b>II</b> result will not have furnishings. We measure this result using a linkage test.</p> <p><b>Did You Know?</b> In breeds that are expected to have furnishings, dogs without furnishings are the exception - this is sometimes called an “improper coat”.</p>	<p><b>Likely furnished (mustache, beard, and/or eyebrows)</b></p>
<p><b>Coat Length</b>   <i>Gene: FGF5</i>   Genetic Result: <b>TT</b></p> <p>This gene is known to affect hair/fur length in many different species, including cats, dogs, mice, and humans. In dogs, a <b>TT</b> result means the dog is likely to have a long, silky coat as seen in the Yorkshire Terrier and the Long Haired Whippet. A <b>GG</b> or <b>GT</b> result is likely to mean a shorter coat, like in the Boxer or the American Staffordshire Terrier.</p> <p><b>Did You Know?</b> In certain breeds, such as Corgi, the long coat is described as “fluff.”</p>	<p><b>Likely long coat</b></p>
<p><b>Shedding</b>   <i>Gene: MC5R</i>   Genetic Result: <b>CT</b></p> <p>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 <b>CC</b> or <b>CT</b> result indicates heavy or seasonal shedding, like many Labradors and German Shepherd Dogs. Dogs with a <b>TT</b> result tend to be lighter shedders, like Boxers, Shih Tzus and Chihuahuas.</p>	<p><b>Likely light shedding</b></p>
<p><b>Coat Texture</b>   <i>Gene: KRT71</i>   Genetic Result: <b>CT</b></p> <p>For dogs with long fur, dogs with a <b>TT</b> or <b>CT</b> result will likely have a wavy or curly coat like the coat of Poodles and Bichon Frises. Dogs with a <b>CC</b> 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.</p> <p><b>Did You Know?</b> Dogs with short coats may have straight coats, whatever result they have for this gene.</p>	<p><b>Likely wavy coat</b></p>
<p><b>Hairlessness (Xolo type) LINKAGE</b>   <i>Gene: FOXI3</i>   Genetic Result: <b>NN</b></p>	

## TRAITS: OTHER COAT TRAITS (CONTINUED)

TRAIT	RESULT
<b>Hairlessness (Terrier type)</b>   <i>Gene: SGK3</i>   Genetic Result: <b>NN</b>  This gene is responsible for Hairlessness in the American Hairless Terrier. Dogs with the <b>ND</b> result are likely to be hairless. Dogs with the <b>NN</b> result are likely to have a normal coat.	<b>Very unlikely to be hairless</b>

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

This gene causes oculocutaneous albinism type 2 (OCA2), also known as Doberman Z Factor Albinism. Dogs with a **DD** result will have OCA2. 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.

## TRAITS: OTHER BODY FEATURES

TRAIT	RESULT
<p><b>Muzzle Length</b>   Gene: <i>BMP3</i>   Genetic Result: <b>CC</b></p> <p>This gene affects muzzle length. A dog with a <b>AC</b> or <b>CC</b> 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 <b>AA</b> result is likely to have a short muzzle, like an English Bulldog, Pug, or Pekingese.</p> <p><b>Did You Know?</b> At least five different genes affect snout length in dogs, with <i>BMP3</i> 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.</p>	<p><b>Likely medium or long muzzle</b></p>
<p><b>Tail Length</b>   Gene: <i>T</i>   Genetic Result: <b>CC</b></p> <p>This is one of the genes that can cause a short bobtail. Most dogs have a <b>CC</b> result and a long tail. Dogs with a <b>CG</b> 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 <b>GG</b> genotypes have not been observed, suggesting that dogs with such a result do not survive to birth.</p> <p><b>Did You Know?</b> 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.</p>	<p><b>Likely normal-length tail</b></p>
<p><b>Hind Dew Claws</b>   Gene: <i>LMBR1</i>   Genetic Result: <b>CC</b></p> <p>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 <b>CT</b> or <b>TT</b> 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.</p> <p><b>Did You Know?</b> Hind dew claws are commonly found in certain breeds such as the Saint Bernard.</p>	<p><b>Unlikely to have hind dew claws</b></p>

## TRAITS: OTHER BODY FEATURES (CONTINUED)

TRAIT	RESULT
<p><b>Back Muscling &amp; Bulk (Large Breed)</b>   Gene: <i>ACSL4</i>   Genetic Result: <b>CC</b></p> <p>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 <b>TT</b> result is likely to have heavy muscling. Leaner-shaped large breed dogs like the Great Dane, Irish Wolfhound, and Scottish Deerhound generally have a <b>CC</b> result. The <b>TC</b> result also indicates likely normal muscling.</p> <p><b>Did You Know?</b> 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.</p>	<b>Likely normal muscling</b>
<p><b>Eye Color LINKAGE</b>   Gene: <i>ALX4</i>   Genetic Result: <b>NN</b></p> <p>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 <b>DupDup</b> or <b>NDup</b> 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 <b>NN</b> result may have blue eyes due to other factors, such as merle or white spotting. We measure this result using a linkage test.</p> <p><b>Did You Know?</b> 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!</p>	<b>Less likely to have blue eyes</b>

## TRAITS: BODY SIZE

### TRAIT

### RESULT

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

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.

**Intermediate**

**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: **TA**

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.

**Intermediate**

**Body Size 4** | Gene: *GHR - E191K* | 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 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**

## 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.

## TRAITS: GENETIC DIVERSITY

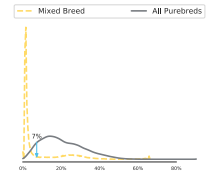
### TRAIT

### RESULT

**Inbreeding** | Gene: *n/a* | Genetic Result: **7%**

**7%**

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.

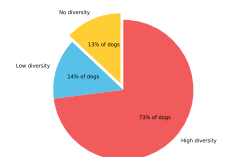


**Immune Response 1** | Gene: *DRB1* | Genetic Result: **No Diversity**

**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 mixed breed dogs:

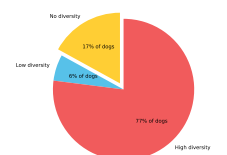


**Immune Response 2** | Gene: *DQA1 and DQB1* | Genetic Result: **No Diversity**

**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. 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 mixed breed dogs:



## 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)

Piper Doodle's baseline ALT level is Low Normal

#### **Why is this important to your vet?**

Piper Doodle has one copy of a variant associated with reduced ALT activity as measured on veterinary blood chemistry panels. Please inform your veterinarian that Piper Doodle has this genotype, as ALT is often used as an indicator of liver health and Piper Doodle is likely to have a lower than average resting ALT activity. As such, an increase in Piper Doodle's ALT activity could be evidence of liver damage, even if it is within normal limits by standard ALT reference ranges.

#### **What is Alanine Aminotransferase Activity?**

The liver enzyme alanine aminotransferase, or ALT, is one of several values your veterinarian measures on routine blood work to gauge liver health.

#### **How vets diagnose this condition**

Genetic testing is the only way to know if your dog has this clinical condition.

#### **How this condition is treated**

No treatment is necessary! Your veterinarian may recommend blood work to establish an individualized baseline ALT value during an annual wellness exam or before starting certain medications. You and your veterinarian would then be able to monitor your dog for any deviation from this established baseline.



## HEALTH REPORT

### How to interpret Piper Doodle's genetic health results:

If Piper Doodle 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 Piper Doodle 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!

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

## BREED-RELEVANT CONDITIONS TESTED



**Piper Doodle did not have the variants that we tested for, that are relevant to her breeds:**

- ✓ Von Willebrand Disease Type I (VWF)
- ✓ Congenital Macrothrombocytopenia (TUBB1 Exon 1, Cavalier King Charles Spaniel Variant)
- ✓ Progressive Retinal Atrophy, prcd (PRCD Exon 1)
- ✓ Golden Retriever Progressive Retinal Atrophy 1, GR-PRA1 (SLC4A3)
- ✓ Golden Retriever Progressive Retinal Atrophy 2, GR-PRA2 (TTC8)
- ✓ Neuronal Ceroid Lipofuscinosis (CLN5 Golden Retriever Variant)
- ✓ GM2 Gangliosidosis (HEXB, Poodle Variant)
- ✓ Degenerative Myelopathy, DM (SOD1A)
- ✓ Neonatal Encephalopathy with Seizures, NEWS (ATF2)
- ✓ Muscular Dystrophy (DMD Golden Retriever Variant)
- ✓ Dystrophic Epidermolysis Bullosa (COL7A1)
- ✓ Ichthyosis (PNPLA1)
- ✓ Osteogenesis Imperfecta, Brittle Bone Disease (COL1A1)
- ✓ Osteochondrodysplasia, Skeletal Dwarfism (SLC13A1)
- ✓ Chondrodystrophy and Intervertebral Disc Disease, CDDY/IVDD, Type I IVDD (FGF4 retrogene - CFA12)

## ADDITIONAL CONDITIONS TESTED



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

- ✔ MDR1 Drug Sensitivity (MDR1)
- ✔ P2Y12 Receptor Platelet Disorder (P2RY12)
- ✔ 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, Shepherd Variant 1)
- ✔ Factor VIII Deficiency, Hemophilia A (F8 Exon 1, Shepherd Variant 2)
- ✔ Thrombopathia (RASGRP2 Exon 5, Basset Hound Variant)
- ✔ Thrombopathia (RASGRP2 Exon 8)
- ✔ Thrombopathia (RASGRP2 Exon 5, American Eskimo Dog Variant)
- ✔ Von Willebrand Disease Type III, Type III vWD (VWF Exon 4)
- ✔ Von Willebrand Disease Type II, Type II vWD (VWF)
- ✔ Canine Leukocyte Adhesion Deficiency Type III, CLAD3 (FERMT3)
- ✔ Canine Elliptocytosis (SPTB Exon 30)
- ✔ Glanzmann's Thrombasthenia Type I (ITGA2B Exon 12)
- ✔ May-Hegglin Anomaly (MYH9)
- ✔ Prekallikrein Deficiency (KLKB1 Exon 8)
- ✔ Pyruvate Kinase Deficiency (PKLR Exon 5)
- ✔ Pyruvate Kinase Deficiency (PKLR Exon 7 Labrador Variant)
- ✔ Pyruvate Kinase Deficiency (PKLR Exon 7 Pug Variant)
- ✔ Pyruvate Kinase Deficiency (PKLR Exon 7 Beagle Variant)
- ✔ Pyruvate Kinase Deficiency (PKLR Exon 10)
- ✔ Trapped Neutrophil Syndrome (VPS13B)

## ADDITIONAL CONDITIONS TESTED

- ✓ Platelet factor X receptor deficiency, Scott Syndrome (TMEM16F)
- ✓ Methemoglobinemia CYB5R3
- ✓ Congenital Hypothyroidism (TPO, Tenterfield Terrier Variant)
- ✓ Complement 3 Deficiency, C3 Deficiency (C3)
- ✓ Severe Combined Immunodeficiency (PRKDC)
- ✓ Severe Combined Immunodeficiency (RAG1)
- ✓ X-linked Severe Combined Immunodeficiency (IL2RG Variant 1)
- ✓ X-linked Severe Combined Immunodeficiency (IL2RG Variant 2)
- ✓ 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 (CNGB1)
- ✓ Progressive Retinal Atrophy (SAG)
- ✓ Progressive Retinal Atrophy, crd1 (PDE6B)
- ✓ Progressive Retinal Atrophy, crd2 (IQCB1)
- ✓ Progressive Retinal Atrophy - crd4/cord1 (RPGRIP1)
- ✓ Collie Eye Anomaly, Choroidal Hypoplasia, CEA (NHEJ1)
- ✓ Achromatopsia (CNGA3 Exon 7 German Shepherd Variant)
- ✓ Achromatopsia (CNGA3 Exon 7 Labrador Retriever Variant)
- ✓ Autosomal Dominant Progressive Retinal Atrophy (RHO)
- ✓ Canine Multifocal Retinopathy (BEST1 Exon 2)
- ✓ Canine Multifocal Retinopathy (BEST1 Exon 5)
- ✓ Canine Multifocal Retinopathy (BEST1 Exon 10 Deletion)
- ✓ Canine Multifocal Retinopathy (BEST1 Exon 10 SNP)
- ✓ Glaucoma (ADAMTS10 Exon 9)

## ADDITIONAL CONDITIONS TESTED

- ✓ Glaucoma (ADAMTS10 Exon 17)
- ✓ Glaucoma (ADAMTS17 Exon 11)
- ✓ Glaucoma (ADAMTS17 Exon 2)
- ✓ Hereditary Cataracts, Early-Onset Cataracts, Juvenile Cataracts (HSF4 Exon 9 Shepherd Variant)
- ✓ Primary Lens Luxation (ADAMTS17)
- ✓ Congenital Stationary Night Blindness (RPE65)
- ✓ Macular Corneal Dystrophy, MCD (CHST6)
- ✓ 2,8-Dihydroxyadenine Urolithiasis, 2,8-DHA Urolithiasis (APRT)
- ✓ Cystinuria Type I-A (SLC3A1)
- ✓ Cystinuria Type II-A (SLC3A1)
- ✓ Cystinuria Type II-B (SLC7A9)
- ✓ Hyperuricosuria and Hyperuricemia or Urolithiasis, HUU (SLC2A9)
- ✓ 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)
- ✓ Primary Ciliary Dyskinesia, PCD (CCDC39 Exon 3)
- ✓ Congenital Keratoconjunctivitis Sicca and Ichthyosiform Dermatitis, Dry Eye Curly Coat Syndrome, CKCSID (FAM83H Exon 5)
- ✓ X-linked Ectodermal Dysplasia, Anhidrotic Ectodermal Dysplasia (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)
- ✓ Glycogen Storage Disease Type IA, Von Gierke Disease, GSD IA (G6PC)
- ✓ Glycogen Storage Disease Type IIIA, GSD IIIA (AGL)

## ADDITIONAL CONDITIONS TESTED

- ✓ Mucopolysaccharidosis Type I, MPS I (IDUA)
- ✓ Mucopolysaccharidosis Type IIIA, Sanfilippo Syndrome Type A, MPS IIIA (SGSH Exon 6 Variant 1)
- ✓ Mucopolysaccharidosis Type IIIA, Sanfilippo Syndrome Type A, MPS IIIA (SGSH Exon 6 Variant 2)
- ✓ Mucopolysaccharidosis Type VII, Sly Syndrome, MPS VII (GUSB Exon 5)
- ✓ Mucopolysaccharidosis Type VII, Sly Syndrome, MPS VII (GUSB Exon 3)
- ✓ 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)
- ✓ Neuronal Ceroid Lipofuscinosis 2, NCL 2 (TPP1 Exon 4)
- ✓ Neuronal Ceroid Lipofuscinosis 1, Cerebellar Ataxia, NCL4A (ARSG Exon 2)
- ✓ Neuronal Ceroid Lipofuscinosis 1, NCL 5 (CLN5 Border Collie Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 6, NCL 6 (CLN6 Exon 7)
- ✓ Neuronal Ceroid Lipofuscinosis 8, NCL 8 (CLN8 English Setter Variant)
- ✓ Neuronal Ceroid Lipofuscinosis (MFSD8)
- ✓ Neuronal Ceroid Lipofuscinosis (CLN8 Australian Shepherd Variant)
- ✓ Neuronal Ceroid Lipofuscinosis 10, NCL 10 (CTSD Exon 5)
- ✓ Adult-Onset Neuronal Ceroid Lipofuscinosis (ATP13A2, Tibetan Terrier Variant)
- ✓ Late-Onset Neuronal Ceroid Lipofuscinosis (ATP13A2, Australian Cattle Dog Variant)
- ✓ GM1 Gangliosidosis (GLB1 Exon 15 Shiba Inu Variant)
- ✓ GM1 Gangliosidosis (GLB1 Exon 15 Alaskan Husky Variant)
- ✓ GM1 Gangliosidosis (GLB1 Exon 2)
- ✓ GM2 Gangliosidosis (HEXA)
- ✓ Globoid Cell Leukodystrophy, Krabbe disease (GALC Exon 5)
- ✓ Autosomal Recessive Amelogenesis Imperfecta, Familial Enamel Hypoplasia (Italian Greyhound Variant)

## ADDITIONAL CONDITIONS TESTED

- ✔ Autosomal Recessive Amelogenesis Imperfecta, Familial Enamel Hypoplasia (Parson Russell Terrier Variant)
- ✔ Persistent Mullerian Duct Syndrome, PMDS (AMHR2)
- ✔ Deafness and Vestibular Syndrome of Dobermans, DVDob, DINGS (MYO7A)
- ✔ Shar-Pei Autoinflammatory Disease, SPAID, Shar-Pei Fever (MTBP)
- ✔ Alaskan Husky Encephalopathy, Subacute Necrotizing Encephalomyelopathy (SLC19A3)
- ✔ Alexander Disease (GFAP)
- ✔ Cerebellar Abiotrophy, Neonatal Cerebellar Cortical Degeneration, NCCD (SPTBN2)
- ✔ Cerebellar Ataxia, Progressive Early-Onset Cerebellar Ataxia (SEL1L)
- ✔ Cerebellar Hypoplasia (VLDLR)
- ✔ Spinocerebellar Ataxia, Late-Onset Ataxia, LoSCA (CAPN1)
- ✔ Spinocerebellar Ataxia with Myokymia and/or Seizures (KCNJ10)
- ✔ Benign Familial Juvenile Epilepsy, Remitting Focal Epilepsy (LGI2)
- ✔ Fetal-Onset Neonatal Neuroaxonal Dystrophy (MFN2)
- ✔ Hypomyelination and Tremors (FNIP2)
- ✔ Shaking Puppy Syndrome, X-linked Generalized Tremor Syndrome (PLP)
- ✔ Neuroaxonal Dystrophy, NAD (Spanish Water Dog Variant)
- ✔ Neuroaxonal Dystrophy, NAD (Rottweiler Variant)
- ✔ L-2-Hydroxyglutaricaciduria, L2HGA (L2HGDH)
- ✔ Polyneuropathy, NDRG1 Greyhound Variant (NDRG1 Exon 15)
- ✔ Polyneuropathy, NDRG1 Malamute Variant (NDRG1 Exon 4)
- ✔ Narcolepsy (HCRTR2 Intron 6)
- ✔ Progressive Neuronal Abiotrophy, Canine Multiple System Degeneration, CMSD (SERAC1 Exon 15)
- ✔ Progressive Neuronal Abiotrophy, Canine Multiple System Degeneration, CMSD (SERAC1 Exon 4)
- ✔ 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)

## ADDITIONAL CONDITIONS TESTED

- ✓ Juvenile-Onset Polyneuropathy, Leonberger Polyneuropathy 1, LPN1 (LPN1, ARHGEF10)
- ✓ Spongy Degeneration with Cerebellar Ataxia 1, SDCA1, SeSAME/EAST Syndrome (KCNJ10)
- ✓ Spongy Degeneration with Cerebellar Ataxia 2, SDCA2 (ATP1B2)
- ✓ Dilated Cardiomyopathy, DCM1 (PDK4)
- ✓ Dilated Cardiomyopathy, DCM2 (TTN)
- ✓ Long QT Syndrome (KCNQ1)
- ✓ Muscular Dystrophy (DMD, Cavalier King Charles Spaniel Variant 1)
- ✓ Muscular Dystrophy (DMD Pembroke Welsh Corgi Variant )
- ✓ Centronuclear Myopathy (PTPLA)
- ✓ Exercise-Induced Collapse (DNM1)
- ✓ Inherited Myopathy of Great Danes (BIN1)
- ✓ Myostatin Deficiency, Bully Whippet Syndrome (MSTN)
- ✓ Myotonia Congenita (CLCN1 Exon 7)
- ✓ Myotonia Congenita (CLCN1 Exon 23)
- ✓ Myotubular Myopathy 1, X-linked Myotubular Myopathy, XL-MTM (MTM1, Labrador Variant)
- ✓ Hypocatalasia, Acatlasemia (CAT)
- ✓ Pyruvate Dehydrogenase Deficiency (PDP1)
- ✓ Malignant Hyperthermia (RYR1)
- ✓ Imerslund-Grasbeck Syndrome, Selective Cobalamin Malabsorption (CUBN Exon 53)
- ✓ Imerslund-Grasbeck Syndrome, Selective Cobalamin Malabsorption (CUBN Exon 8)
- ✓ Lunde hund Syndrome (LEPREL1)
- ✓ Congenital Myasthenic Syndrome (CHAT)
- ✓ Congenital Myasthenic Syndrome (COLQ)
- ✓ Episodic Falling Syndrome (BCAN)
- ✓ Ectodermal Dysplasia, Skin Fragility Syndrome (PKP1)



## ADDITIONAL CONDITIONS TESTED

- ✔ Ichthyosis, Epidermolytic Hyperkeratosis (KRT10)
- ✔ Ichthyosis (SLC27A4)
- ✔ Ichthyosis (NIPAL4)
- ✔ Focal Non-Epidermolytic Palmoplantar Keratoderma, Pachyonychia Congenita (KRT16)
- ✔ Hereditary Footpad Hyperkeratosis (FAM83G)
- ✔ Hereditary Nasal Parakeratosis (SUV39H2)
- ✔ Musladin-Lueke Syndrome (ADAMTSL2)
- ✔ Bald Thigh Syndrome (IGFBP5)
- ✔ Cleft Lip and/or Cleft Palate (ADAMTS20)
- ✔ Hereditary Vitamin D-Resistant Rickets (VDR)
- ✔ Oculoskeletal Dysplasia 1, Dwarfism-Retinal Dysplasia, OSD1 (COL9A3, Labrador Retriever)
- ✔ Osteogenesis Imperfecta, Brittle Bone Disease (COL1A2)
- ✔ Osteogenesis Imperfecta, Brittle Bone Disease (SERPINH1)
- ✔ Skeletal Dysplasia 2, SD2 (COL11A2)
- ✔ Craniomandibular Osteopathy, CMO (SLC37A2)
- ✔ Chondrodystrophy, Norwegian Elkhound and Karelian Bear Dog Variant (ITGA10)