Name: **Green Meadow Millie**
AKC #: **WS709845/03**
Birth Date: **12/17/2020**
Colors/Markings: **Black Rust & White**
Breeder(s): **Atlee Weaver**

Breed/Variety: **Bernese Mountain Dog**
Sex: **Female**

<table>
<tr><td rowspan="16">Green Meadow Millie
WS709845/03
Black Rust & White</td><td rowspan="8">Valiant Knight Ot Zennenhund Rossii
WS637298/01 08-19 (Russia)
Black Rust & White
AKC DNA #V880788</td><td rowspan="4">Sennenhund Rossii Zhoker
RKF 4014054</td><td rowspan="2">Sennenhund Rossii Kriskent
RKF 3211523</td><td>Sennenhund Rossii Ferdinand
RKF 2844167</td><td>Lad's Bogart
RKF 2179190</td></tr>
<tr><td>Zhaklin Feser Sennenhund Rossii
RKF 2418452</td></tr>
<tr><td>Sennenhund Rossii Alberta
RKF 2027947</td><td>(Not Available Online)</td></tr>
<tr><td>(Not Available Online)</td></tr>
<tr><td rowspan="2">Terra De Bern Vetta For Sennenhung Rossii
RKF 3356982</td><td>Emillion V. 'T Rijkenspark
NHSB 2757252</td><td>CH Zanzebern Defender
WS240523/01 06-08 (Australia)
Black Tan & White
OFA35E OFEL35 AKC DNA #V495489</td></tr>
<tr><td>Zeni Nora V.'T Rijkenspark
NHSB 2589164</td></tr>
<tr><td rowspan="4">Sennenhund Rossii Zheneva II
RKF 3753784</td><td rowspan="2">Ciceron
RKF 1842912</td><td>Terra De Bern Sharlotta
RKF 2698255</td><td>Espahan Maximus V. 'T Rijkenspark
NHSB 2624081</td></tr>
<tr><td>Quinta De La Rosa Av Milkcreek
RKF 2038445</td></tr>
<tr><td>Lord V.Geissberg
NHSB 613618</td><td>(Not Available Online)</td></tr>
<tr><td>(Not Available Online)</td></tr>
<tr><td rowspan="2">Berni Zonen Land Kadril
RKF 1375475</td><td>(Not Available Online)</td></tr>
<tr><td>(Not Available Online)</td></tr>
<tr><td rowspan="8">Hemis Callie
WS631831/01 04-21
Black Rust & White</td><td rowspan="4">Hemi Of High Country
WS512708/02 06-17
Black Rust & White
AKC DNA #V858815</td><td rowspan="2">CH Black Mountain Berner Hansel
WS452399/04 01-15
Black Rust & White
OFA26G OFEL26 AKC DNA #V735733</td><td>GCHB CH Snowbiz's Blackmountain Berner Schultz
WS391068/04 01-13
Black Rust & White
None OFEL AKC DNA #V670308</td><td>Highlander Van'T Pachthof
WS313868/01 02-10 (Belgium)
Black Rust & White
AKC DNA #V592867</td></tr>
<tr><td>Geneva Van 'T Stokerybos
WS261643/02 11-09 (Belgium)
Black Rust & White
AKC DNA #V548509</td></tr>
<tr><td rowspan="2">Blackmountain Berners Leah
WS374143/05 01-14
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OFA57G OFEL57</td><td>High Country Clyde
WS311182/04 03-11
Black Rust & White
AKC DNA #V636649</td></tr>
<tr><td>Rojo's Chasseral Jaiki'
WS249862/07 06-10
Black Rust & White</td></tr>
<tr><td rowspan="2">Hemingwayh Katie Lou
WS355080/01 05-12
Black Rust & White</td><td>Hemingwayh Van 'T Pachthof
WS305931/01 03-10 (Belgium)
Black Tan & White
AKC DNA #V586333</td><td>Batch Santy Bazaltin
CMKU 2552/01</td></tr>
<tr><td>Katie Lou Valentine
WS094253/01 04-06
Black Rust & White
OFA29G</td><td>Bernice Van 'T Beertjes Hof
UCS 0903118</td></tr>
<tr><td rowspan="4">Izzy Joy
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Black Rust & White</td><td rowspan="2">Samson XXIII
WS477758/05 12-15
Black Rust & White
AKC DNA #V791892</td><td>Skyviews Tiny Bear
WS392539/03 10-13
Black Tan & White
AKC DNA #V718379</td><td>Brutus Boaz Elohim
WR076915/02 11-04
Black Rust & White
OFA40G AKC DNA #V361587</td></tr>
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WS406923/03 11-14
Black Rust & White</td><td>Ellanorha May Valentine
WS042931/05 11-04
Black Tan & White</td></tr>
<tr><td rowspan="2">Penny V
WS456105/06 12-15
Black Rust & White</td><td>Whispering Pines Clyde
WS337965/11 08-11
Black Rust & White
AKC DNA #V691253</td></tr>
<tr><td>Oh Henry The King
WS371749/01 09-12
Black Rust & White</td><td>Whisper Winds Whitney
WS306727/02 08-11
Black Rust & White</td></tr>
<tr><td rowspan="2">Willowbrook Black Beauty
WS315655/06 09-11
Black Rust & White</td><td>Mechanic Mack
WS366163/03 08-12
Black Rust & White</td></tr>
<tr><td>Reba Jack
WS166583/05 04-09
Black Rust & White</td></tr>
<tr><td rowspan="2">Willowbrook Prince
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Black Rust & White
AKC DNA #V650743</td></tr>
<tr><td>Willowbrook Sierra
WS292544/03 01-11
Black Rust & White</td></tr>
<tr><td rowspan="2">Troyers Buster
WS028898/01 11-04
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AKC DNA #V452493</td></tr>
<tr><td>Tujaligeti Bettina
WS106473/01 03-05 (Hungary)
Black Rust & White</td></tr>
</table>

Please separate below and keep for your records.

990005005042136

AMERICAN KENNEL CLUB

NAME
GREEN MEADOW MILLIE

BREED
BERNESE MOUNTAIN DOG

COLOR
BLACK RUST & WHITE

SIRE
VALIANT KNIGHT OT ZENNENHUND ROSSII
WS63729801 08-19 (AKC DNA #V880788) (RUS)

DAM
HEMIS CALLIE
WS63183101 04-21

BREEDER
ATLEE WEAVER

OWNER

ADEN A MILLER
4503 TOWNSHIP ROAD 606
FREDERICKSBURG OH 44627-9604

NUMBER
WS70984503

SEX
FEMALE

DATE OF BIRTH
DECEMBER 17, 2020

AMERICAN KENNEL CLUB®

CERTIFICATE ISSUED
APRIL 13, 2023

This certificate invalidates all previous certificates issued.

If a date appears after the name and number of the sire and dam, it indicates the issue of the Stud Book Register in which the sire or dam is published.

For Transfer Instructions, see back of Certificate.

This Certificate issued with the right to correct or revoke by the American Kennel Club.

REGISTRATION CERTIFICATE

Orthopedic Foundation for Animals

Elbow Dysplasia Evaluation Report

A Not-for-Profit Organization

GREEN MEADOW MILLIE
registered name

BERNESE MOUNTAIN DOG
breed

film/test/lab #

990005005042136
tattoo/microchip/DNA profile

2503218
application number

11/20/2023
date of report

WS70984503
registration no.

F
sex

12/17/2020
date of birth

34
age at evaluation in months

BMD-EL17018F34-C-VPI
O.F.A. NUMBER

This number issued with the right to correct or revoke by the Orthopedic Foundation for Animals.

Veterinarian

HOLMES WAYNE VETERINARY SERVICES
8461 STATE ROUTE 241
FREDERICKSBURG OH 44627

Owner

ADEN MILLER
4503 TOWNSHIP ROAD 606
FREDERICKSBURG OH 44627

RADIOGRAPHIC EVALUATION OF PHENOTYPE WITH RESPECT TO ELBOW DYSPLASIA

ELBOW JOINTS -- FLEXED LATERAL VIEW

√ negative for elbow dysplasia	L √	R √

ELBOW DYSPLASIA

GRADE I	L _____	R _____
GRADE II	L _____	R _____
GRADE III	L _____	R _____

RADIOGRAPHIC FINDINGS

degenerative joint disease (DJD)	L _____	R _____
ununited anconeal process (UAP)	L _____	R _____
fragmented coronoid process (FCP)	L _____	R _____
osteochondrosis	L _____	R _____

G.G. KELLER, DVM, MS, DACVR
CHIEF OF VETERINARY SERVICES

2300 E Nifong Blvd | Columbia MO 65201 | Phone (573) 442-0418 | Fax (573) 875-5073 | ofa@offa.org | www.ofa.org

Orthopedic Foundation for Animals

Hip Dysplasia Evaluation Report

A Not-for-Profit Organization

GREEN MEADOW MILLIE
registered name

BERNESE MOUNTAIN DOG
breed

film/test/lab #

990005005042136
tattoo/microchip/DNA profile

2503218
application number

11/20/2023
date of report

WS70984503
registration no.

F
sex

12/17/2020
date of birth

34
age at evaluation in months

BMD-27067G34F-C-VPI
O.F.A. NUMBER

This number issued with the right to correct or revoke by the Orthopedic Foundation for Animals.

Veterinarian

HOLMES WAYNE VETERINARY SERVICES
8461 STATE ROUTE 241
FREDERICKSBURG OH 44627

Owner

ADEN MILLER
4503 TOWNSHIP ROAD 606
FREDERICKSBURG OH 44627

RADIOGRAPHIC EVALUATION OF PELVIC PHENOTYPE WITH RESPECT TO HIP DYSPLASIA

_____ **EXCELLENT HIP JOINT CONFORMATION**
superior hip joint conformation as compared with other individuals of the same breed and age

_√_ **GOOD HIP JOINT CONFORMATION**
well formed hip joint conformation as compared with other individuals of the same breed and age

_____ **FAIR HIP JOINT CONFORMATION**
minor irregularities of the hip joint conformation as compared with other individuals of the same breed and age

_____ **BORDERLINE HIP JOINT CONFORMATION**
marginal hip joint conformation of indeterminate status with respect to hip dysplasia at this time -- Repeat study in six months

_____ **MILD HIP DYSPLASIA**
radiographic evidence of minor dysplastic changes of the hip joints

_____ **MODERATE HIP DYSPLASIA**
well defined radiographic evidence of dysplastic changes of the hip joints

_____ **SEVERE HIP DYSPLASIA**
radiographic evidence of marked dysplastic changes of the hip joints

RADIOGRAPHIC FINDINGS

_____ subluxation
_____ remodeling of femoral head/neck
_____ osteoarthritis/degenerative joint disease
_____ shallow acetabula
_____ acetabular rim/edge change

_____ unilateral _____ left _____ right
_____ transitional vertebra
_____ spondylosis
_____ panosteitis

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2300 E Nifong Blvd | Columbia MO 65201 | Phone (573) 442-0418 | Fax (573) 875-5073 | ofa@offa.org | www.ofa.org

CERTIFICATE OF RESULTS

OWNERS NAME:	ARIE MILLER
PET'S NAME:**	JILL
PET'S REGISTRATION #:	NOT PROVIDED
PET'S BREED:	BERNESE MOUNTAIN DOG
TEST:	SOD1B DEGENERATIVE MYELOPATHY
DATE:	6/28/2023

Test Score Explanation:

(CLEAR/NORMAL): These dogs have two copies of the normal gene and will not develop degenerative myelopathy due to this mutation.

TEST SCORE*:

A

SAMPLE ID #:
426479

For detailed result explanation please visit our website:

www.GenSolDx.com

*All samples submitted to GenSol become the property of GenSol and may be used for internal quality control and/or research purposes. Test results provide information concerning a pet's DNA sequence and are not an indication or guarantee of pet's disease state or condition. Test results alone should not be used to diagnosis, treat or prevent disease.

**GenSol warrants its test results to be accurate for the sample obtained from the above dog. In the event of a valid claim, owner's sole remedy is a refund of the fee paid. IN NO EVENT SHALL GENSOL BE LIABLE FOR INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND. Any claim must be asserted within one year of the report of test results.

Please consult a licensed veterinarian to discuss the implications of the above test results.

125 North Main Street Unit 1846, Clayton, GA 30525

1-844-369-3686 - info@Gensoldx.com

WWW.GENSOLDX.COM

JILL

DNA Test Report | Test Date: June 24th, 2023 | embk.me/sandra12

BREED ANCESTRY

Bernese Mountain Dog : 100.0%

GENETIC STATS

Predicted adult weight: **79 lbs**

TEST DETAILS

Kit number: EM-19663236
Swab number: 31220412301831

Registration: American Kennel Club (AKC)

JILL

DNA Test Report | Test Date: June 24th, 2023 | embk.me/sandra12

Fun Fact

Berners can haul up to 1,000 pounds - 10 times their weight!

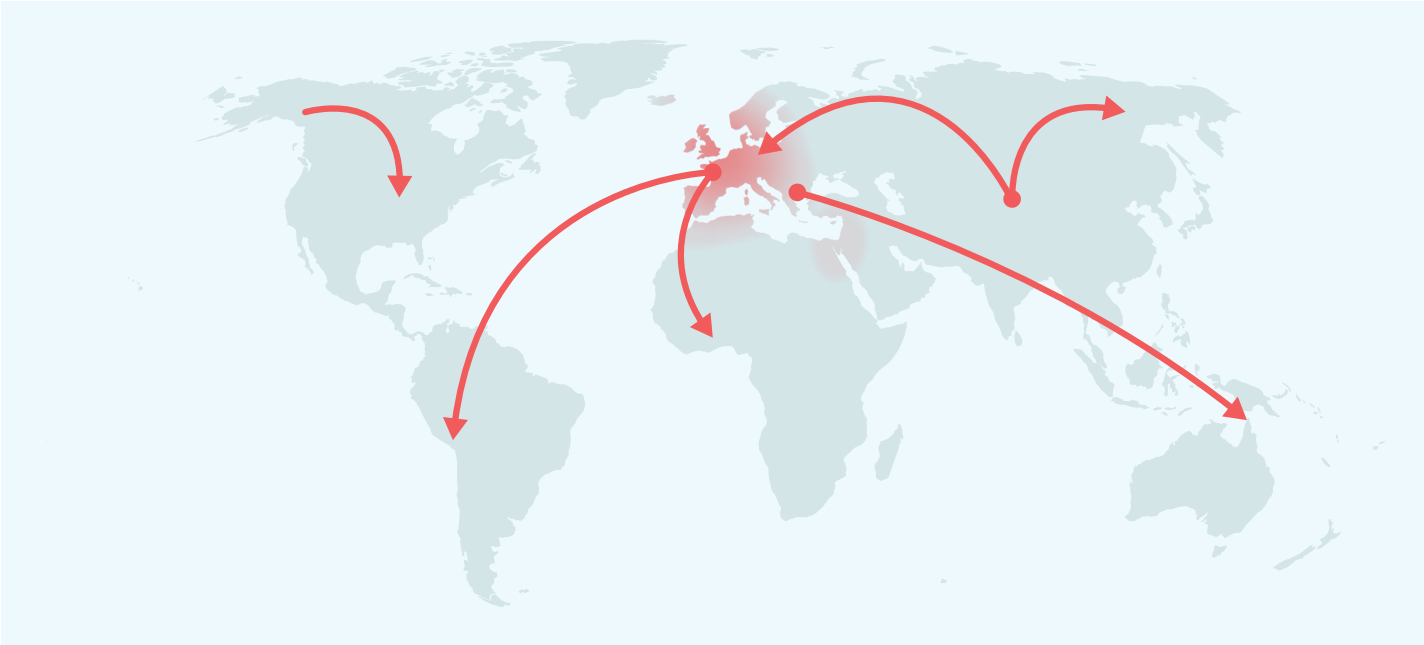
BERNESE MOUNTAIN DOG

The Bernese Mountain Dog, commonly referred to as a 'Berner', is a versatile working dog that is both visually pleasing and a loyal companion. The Bernese Mountain Dog was bred to herd cattle, pull carts and be a watchdog in the Swiss farmlands. The ancient 'Molosser' breed is considered the main contributor to Mastiff-type dogs, which include the Berner. It is likely that the Molosser bred with farm dogs from the Swiss Alps in the first century B.C., developing a number of Swiss Sennenhund ("mountain dog") breeds, including the Berner Sennenhund. It is thought that the Berner continued working on these Swiss farmlands for over 2,000 years, before their primary purpose switched from herding cattle to appearing as a show dog in the early 20th century. They were first classified as the Bernese Mountain Dog at this time by the Swiss Kennel Club. Following World War I, in which the breed nearly became extinct, Berners were exported to America before being accepted by the AKC as an official breed in 1937. Breed development faltered somewhat during World War II before Berners became an established and popular breed in the mid to late 20th century. This easygoing breed likes to be around their owners, where their calm and intelligent nature makes them a beloved family dog. Berners exhibit their working dog instincts in their willingness to learn and relative ease to be trained. Their heritage also often results in being protective and sometimes shy towards new people and dogs. Early socialization training allows the Bernese Mountain Dog to learn to overcome initial caution around new things. This breed is a large dog, weighing around 100 pounds, and likes to keep busy, so it is important training is conducted while young and manageable. While they are well-tempered dogs, they are slow to mature and often exhibit puppy behavior for a number of years before reaching full maturity. Due to their beautiful and thick double coat, Berners tend to shed generously, requiring frequent brushing to keep under control. Unfortunately, owing to their size and limited gene pool, Bernese Mountain Dogs are prone to health problems and have a life expectancy of between 6-8 years. Nonetheless, this lovable dog

JILL

DNA Test Report | Test Date: June 24th, 2023 | embk.me/sandra12

MATERNAL LINE



Through Jill'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: A1e

This female lineage likely stems from some of the original Central Asian wolves that were domesticated into modern dogs starting about 15,000 years ago. It seemed to be a fairly rare dog line for most of dog history until the past 300 years, when the lineage seemed to "explode" out and spread quickly. What really separates this group from the pack is its presence in Alaskan village dogs and Samoyeds. It is possible that this was an indigenous lineage brought to the Americas from Siberia when people were first starting to make that trip themselves! We see this lineage pop up in overwhelming numbers of Irish Wolfhounds, and it also occurs frequently in popular large breeds like Bernese Mountain Dogs, Saint Bernards and Great Danes. Shetland Sheepdogs are also common members of this maternal line, and we see it a lot in Boxers, too. Though it may be all mixed up with European dogs thanks to recent breeding events, its origins in the Americas makes it a very exciting lineage for sure!

HAPLOTYPE: A228

Part of the large A1e haplogroup, we have spotted this haplotype in village dogs in the Democratic Republic of the Congo and in the Dominican Republic. Among breeds, we see it frequently in big dogs like Saint Bernards, Leonbergers, and Great Danes. However, we also see it in small breeds including wire Fox Terriers and Rat Terriers. That's a pretty wide size range!

JILL

TRAITS: COAT COLOR

TRAIT	RESULT
E Locus (MC1R) The E Locus determines if and where a dog can produce dark (black or brown) hair. Dogs with two copies of the recessive **e** allele do not produce dark hairs at all, and will be "red" over their entire body. The shade of red, which can range from a deep copper to yellow/gold to cream, is dependent on other genetic factors including the Intensity loci. In addition to determining if a dog can develop dark hairs at all, the E Locus 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 the **Em** allele usually have a melanistic mask (dark facial hair as commonly seen in the German Shepherd and Pug). Dogs with no copies of **Em** but one or two copies of the **Eg** allele usually have a melanistic "widow's peak" (dark forehead hair as commonly seen in the Afghan Hound and Borzoi, where it is called either "grizzle" or "domino").	**No dark mask or grizzle (EE)**
K Locus (CBD103) The K Locus K^B allele "overrides" the A Locus, meaning that it prevents the A Locus genotype from affecting coat color. For this reason, the K^B allele is referred to as the "dominant black" allele. As a result, dogs with at least one K^B allele will usually have solid black or brown coats (or red/cream coats if they are **ee** at the E Locus) regardless of their genotype at the A Locus, although several other genes could impact the dog's coat and cause other patterns, such as white spotting. Dogs with the k^yk^y genotype will show a coat color pattern based on the genotype they have at the A Locus. Dogs who test as K^Bk^y may be brindle rather than black or brown.	**More likely to have a patterned haircoat (k^yk^y)**

TRAITS: COAT COLOR (CONTINUED)

TRAIT	RESULT
Intensity Loci LINKAGE Areas of a dog's coat where dark (black or brown) pigment is not expressed either contain red/yellow pigment, or no pigment at all. Five locations across five chromosomes explain approximately 70% of red pigmentation "intensity" variation across all dogs. Dogs with a result of **Intense Red Pigmentation** will likely have deep red hair like an Irish Setter or "apricot" hair like some Poodles, dogs with a result of **Intermediate Red Pigmentation** will likely have tan or yellow hair like a Soft-Coated Wheaten Terrier, and dogs with **Dilute Red Pigmentation** will likely have cream or white hair like a Samoyed. Because the mutations we test may not directly cause differences in red pigmentation intensity, we consider this to be a linkage test.	**Any light hair likely yellow or tan (Intermediate Red Pigmentation)**
A Locus (ASIP) The A Locus controls switching between black and red pigment in hair cells, but it will only be expressed in dogs that are not **ee** at the E Locus and are **$k^y k^y$** at the K Locus. Sable (also called "Fawn") dogs have a mostly or entirely red coat with some interspersed black hairs. Agouti (also called "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.	**Black/Brown and tan coat color pattern ($a^t a^t$)**
D Locus (MLPH) 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 two **d** alleles, regardless of which variant, will have all black pigment lightened ("diluted") to gray, or brown pigment lightened to lighter brown in their hair, skin, and sometimes eyes. There are many breed-specific names for these dilute colors, such as "blue", "charcoal", "fawn", "silver", and "Isabella". Note that in certain breeds, dilute dogs have a higher incidence of Color Dilution Alopecia. Dogs with one **d** allele will not be dilute, but can pass the **d** allele on to their puppies. 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 areas of hair and skin are not lightened (DD)**

TRAITS: COAT COLOR (CONTINUED)

TRAIT	RESULT
Cocoa (HPS3) Dogs with the **coco** genotype will produce dark brown pigment instead of black in both their hair and skin. Dogs with the **Nco** genotype will produce black pigment, but can pass the **co** allele on to their puppies. Dogs that have the **coco** genotype as well as the **bb** genotype at the B locus are generally a lighter brown than dogs that have the **Bb** or **BB** genotypes at the B locus.	**No co alleles, not expressed (NN)**
B Locus (TYRP1) Dogs with two copies of the **b** allele produce brown pigment instead of black in both their hair and skin. Dogs with one copy of the **b** allele will produce black pigment, but can pass the **b** allele on to their puppies. E Locus **ee** dogs that carry two **b** alleles will have red or cream coats, but have brown noses, eye rims, and footpads (sometimes referred to as "Dudley Nose" in Labrador Retrievers). "Liver" or "chocolate" is the preferred color term for brown in most breeds; in the Doberman Pinscher it is referred to as "red".	**Black or gray hair and skin (BB)**
Saddle Tan (RALY) 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 $\mathbf{a^t}$ allele, so dogs that do not express $\mathbf{a^t}$ are not influenced by this gene.	**Not saddle tan patterned (II)**
S Locus (MITF) The S Locus determines white spotting and pigment distribution. MITF controls where pigment is produced, and an insertion in the MITF gene causes a loss of pigment in the coat and skin, resulting in white hair and/or pink skin. Dogs with two copies of this variant will likely have breed-dependent white patterning, with a nearly white, parti, or piebald coat. Dogs with one copy of this variant will have more limited white spotting and may be considered flash, parti or piebald. This MITF variant does not explain all white spotting patterns in dogs and other variants are currently being researched. Some dogs may have small amounts of white on the paws, chest, face, or tail regardless of their S Locus genotype.	**Likely to have little to no white in coat (SS)**

TRAITS: COAT COLOR (CONTINUED)

TRAIT	RESULT
M Locus (PMEL) Merle coat patterning is common to several dog breeds including the Australian Shepherd, Catahoula Leopard Dog, and Shetland Sheepdog, among many others. Merle arises from an unstable SINE insertion (which we term the "M*" allele) that disrupts activity of the pigmentary gene PMEL, leading to mottled or patchy coat color. Dogs with an **M*m** result are likely to be phenotypically merle or could be "non-expressing" merle, meaning that the merle pattern is very subtle or not at all evident in their coat. Dogs with an **M*M*** result are likely to be phenotypically merle or double merle. Dogs with an **mm** result have no merle alleles and are unlikely to have a merle coat pattern. Note that Embark does not currently distinguish between the recently described cryptic, atypical, atypical+, classic, and harlequin merle alleles. Our merle test only detects the presence, but not the length of the SINE insertion. We do not recommend making breeding decisions on this result alone. Please pursue further testing for allelic distinction prior to breeding decisions.	**No merle alleles (mm)**
R Locus (USH2A) LINKAGE The R Locus regulates the presence or absence of the roan coat color pattern. Partial duplication of the USH2A gene is strongly associated with this coat pattern. Dogs with at least one **R** allele will likely have roaning on otherwise uniformly unpigmented white areas. Roan appears in white areas controlled by the S Locus but not in other white or cream areas created by other loci, such as the E Locus with **ee** along with Dilute Red Pigmentation by I Locus (for example, in Samoyeds). Mechanisms for controlling the extent of roaning are currently unknown, and roaning can appear in a uniform or non-uniform pattern. Further, non-uniform roaning may appear as ticked, and not obviously roan. The roan pattern can appear with or without ticking.	**Likely no impact on coat pattern (rr)**
H Locus (Harlequin) 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. This trait is thought to be homozygous lethal; a living dog with an **HH** genotype has never been found.	**No harlequin alleles (hh)**

TRAITS: OTHER COAT TRAITS

TRAIT	RESULT
Furnishings (RSPO2) LINKAGE Dogs with one or two copies of the **F** allele have "furnishings": the mustache, beard, and eyebrows characteristic of breeds like the Schnauzer, Scottish Terrier, and Wire Haired Dachshund. A dog with two **I** alleles will not have furnishings, which is sometimes called an "improper coat" in breeds where furnishings are part of the breed standard. The mutation is a genetic insertion which we measure indirectly using a linkage test highly correlated with the insertion.	**Likely unfurnished (no mustache, beard, and/or eyebrows) (II)**
Coat Length (FGF5) The FGF5 gene is known to affect hair length in many different species, including cats, dogs, mice, and humans. In dogs, the **T** allele confers a long, silky haircoat as observed in the Yorkshire Terrier and the Long Haired Whippet. The ancestral **G** allele causes a shorter coat as seen in the Boxer or the American Staffordshire Terrier. In certain breeds (such as Corgi), the long haircoat is described as "fluff."	**Likely long coat (TT)**
Shedding (MC5R) Dogs with at least one copy of the ancestral **C** allele, like many Labradors and German Shepherd Dogs, are heavy or seasonal shedders, while those with two copies of the **T** allele, including many Boxers, Shih Tzus and Chihuahuas, tend to be lighter shedders. Dogs with furnished/wire-haired coats caused by RSPO2 (the furnishings gene) tend to be low shedders regardless of their genotype at this gene.	**Likely heavy/seasonal shedding (CT)**
Hairlessness (FOXI3) LINKAGE A duplication in the FOXI3 gene causes hairlessness over most of the body as well as changes in tooth shape and number. This mutation occurs in Peruvian Inca Orchid, Xoloitzcuintli (Mexican Hairless), and Chinese Crested (other hairless breeds have different mutations). Dogs with the **NDup** genotype are likely to be hairless while dogs with the **NN** genotype are likely to have a normal coat. The **DupDup** genotype has never been observed, suggesting that dogs with that genotype cannot survive to birth. Please note that this is a linkage test, so it may not be as predictive as direct tests of the mutation in some lines.	**Very unlikely to be hairless (NN)**
Hairlessness (SGK3) Hairlessness in the American Hairless Terrier arises from a mutation in the SGK3 gene. Dogs with the **DD** result are likely to be hairless. Dogs with the **ND** genotype will have a normal coat, but can pass the **D**	**Very unlikely to be hairless (NN)**

TRAITS: OTHER COAT TRAITS (CONTINUED)

TRAIT	RESULT
Oculocutaneous Albinism Type 2 (SLC45A2) LINKAGE Dogs with two copies **DD** of this deletion in the SLC45A2 gene have oculocutaneous albinism (OCA), also known as Doberman Z Factor Albinism, a recessive condition characterized by severely reduced or absent pigment in the eyes, skin, and hair. Affected dogs sometimes suffer from vision problems due to lack of eye pigment (which helps direct and absorb ambient light) and are prone to sunburn. Dogs with a single copy of the deletion **ND** will not be affected but can pass the mutation on to their offspring. 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. Please note that this is a linkage test, so it may not be as predictive as direct tests of the mutation in some lines.	**Likely not albino (NN)**
Coat Texture (KRT71) Dogs with a long coat and at least one copy of the **T** allele have a wavy or curly coat characteristic of Poodles and Bichon Frises. Dogs with two copies of the ancestral **C** allele are likely to have a straight coat, but there are other factors that can cause a curly coat, for example if they at least one **F** allele for the Furnishings (RSPO2) gene then they are likely to have a curly coat. Dogs with short coats may carry one or two copies of the **T** allele but still have straight coats.	**Likely straight coat (CC)**

TRAITS: OTHER BODY FEATURES

TRAIT	RESULT
Muzzle Length (BMP3) Dogs in medium-length muzzle (mesocephalic) breeds like Staffordshire Terriers and Labradors, and long muzzle (dolichocephalic) breeds like Whippet and Collie have one, or more commonly two, copies of the ancestral **C** allele. Dogs in many short-length muzzle (brachycephalic) breeds such as the English Bulldog, Pug, and Pekingese have two copies of the derived **A** allele. At least five different genes affect muzzle length in dogs, with BMP3 being the only one with a known causal mutation. For example, the skull shape of some breeds, including the dolichocephalic Scottish Terrier or the brachycephalic Japanese Chin, appear to be caused by other genes. Thus, dogs may have short or long muzzles due to other genetic factors that are not yet known to science.	**Likely medium or long muzzle (CC)**
Tail Length (T) Whereas most dogs have two **C** alleles and a long tail, dogs with one **G** allele are likely to have a bobtail, which is an unusually short or absent tail. This mutation causes natural bobtail in many 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 the **GG** genotype do not survive to birth. Please note that this mutation does not explain every natural bobtail! 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, these breeds do not have this mutation. This suggests that other unknown genetic mutations can also lead to a natural bobtail.	**Likely normal-length tail (CC)**
Hind Dewclaws (LMBR1) Common in certain breeds such as the Saint Bernard, hind dewclaws are extra, nonfunctional digits located midway between a dog's paw and hock. Dogs with at least one copy of the **T** allele have about a 50% chance of having hind dewclaws. Note that other (currently unknown to science) mutations can also cause hind dewclaws, so some **CC** or **TC** dogs will have hind dewclaws.	**Likely to have hind dew claws (CT)**

TRAITS: OTHER BODY FEATURES (CONTINUED)

TRAIT	RESULT
Blue Eye Color (ALX4) LINKAGE Embark researchers discovered this large duplication associated with blue eyes in Arctic breeds like Siberian Husky as well as tri-colored (non-merle) Australian Shepherds. Dogs with at least one copy of the duplication (**Dup**) are more likely to have at least one blue eye. Some dogs with the duplication may have only one blue eye (complete heterochromia) or may not have blue eyes at all; nevertheless, they can still pass the duplication and the trait to their offspring. **NN** dogs do not carry this duplication, but may have blue eyes due to other factors, such as merle. Please note that this is a linkage test, so it may not be as predictive as direct tests of the mutation in some lines.	**Less likely to have blue eyes (NN)**
Back Muscling & Bulk, Large Breed (ACSL4) The **T** allele is associated with 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. The "bulky" **T** allele is absent from leaner shaped large breed dogs like the Great Dane, Irish Wolfhound, and Scottish Deerhound, which are fixed for the ancestral **C** allele. Note that this mutation does not seem to affect muscling in small or even mid-sized dog breeds with notable back muscling, including the American Staffordshire Terrier, Boston Terrier, and the English Bulldog.	**Likely normal muscling (TC)**

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TRAITS: BODY SIZE

TRAIT	RESULT
Body Size (IGF1) The **I** allele is associated with smaller body size.	**Larger (NN)**
Body Size (IGFR1) The **A** allele is associated with smaller body size.	**Larger (GG)**
Body Size (STC2) The **A** allele is associated with smaller body size.	**Larger (TT)**
Body Size (GHR - E191K) The **A** allele is associated with smaller body size.	**Intermediate (GA)**
Body Size (GHR - P177L) The **T** allele is associated with smaller body size.	**Larger (CC)**

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TRAITS: PERFORMANCE

TRAIT	RESULT
Altitude Adaptation (EPAS1) This mutation causes dogs to be especially tolerant of low oxygen environments (hypoxia), such as those found at high elevations. Dogs with at least one **A** allele are less susceptible to "altitude sickness." This mutation was originally identified in breeds from high altitude areas such as the Tibetan Mastiff.	**Normal altitude tolerance (GG)**
Appetite (POMC) LINKAGE This mutation in the POMC gene is found primarily in Labrador and Flat Coated Retrievers. Compared to dogs with no copies of the mutation (**NN**), dogs with one (**ND**) or two (**DD**) copies of the mutation are more likely to have high food motivation, which can cause them 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 (NN)**