embark™

Certificate of Breed

OWNER'S NAME: Stephanie Mitchell

DOG'S NAME: Timber of the Shenandoah

TEST DATE: July 3rd, 2017

This certifies the authenticity of **Timber of the Shenandoah**'s canine genetic background as determined following careful analysis of more than 200,000 genetic markers.

Welcome to the **Embark** family!

GOLDEN RETRIEVER

WOLFINESS **0.8% MEDIUM**

MATERNAL HAPLOTYPE **B1b**

PATERNAL HAPLOTYPE **H1a.20**

Adam Boyko, Ph.D.
CHIEF SCIENCE OFFICER

Ryan Boyko
CHIEF EXECUTIVE OFFICER

TIMBER OF THE SHENANDOAH

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GENETIC STATS

Wolfiness: 0.8 % **MEDIUM**
Predicted adult weight: **74 lbs**
Genetic age: **44 human years**

TEST DETAILS

Kit number: EM-3452498
Swab number: 31001701023373

Registration: AKC SR79441803

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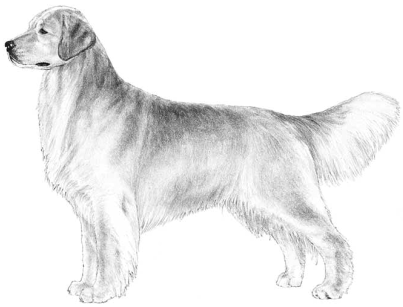

Fun Fact A Golden Retriever is also pictured in the Guinness Book of World's Records for "Most tennis balls held in mouth" (with 15).

GOLDEN RETRIEVER

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

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MATERNAL LINE

Through Timber of the Shenandoah's mitochondrial DNA we can trace his mother's ancestry back to where dogs and people first became friends. This map helps you visualize the routes that his 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: B1b

Part of the large B1 haplogroup, we see this haplotype in village dogs across the world, including those from Central America, the Middle East, South Asia, and the French Polynesian Islands. Among the 31 breed dogs we see it in, we see it in Poodles, Otterhounds, and Labrador Retrievers. It is also our most commonly-sampled Golden Retriever haplotype!

TIMBER OF THE SHENANDOAH

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PATERNAL LINE

Through Timber of the Shenandoah's Y chromosome we can trace his father's ancestry back to where dogs and people first became friends. This map helps you visualize the routes that his ancestors took to your home. Their story is described below the map.

HAPLOGROUP: A1a

Some of the wolves that became the original dogs in Central Asia around 15,000 years ago came from this long and distinguished line of male dogs. After domestication, they followed their humans from Asia to Europe and then didn't stop there. They took root in Europe, eventually becoming the dogs that founded the Vizsla breed 1,000 years ago. The Vizsla is a Central European hunting dog, and all male Vizslas descend from this line. During the Age of Exploration, like their owners, these pooches went by the philosophy, "Have sail, will travel!" From the windy plains of Patagonia to the snug and homey towns of the American Midwest, the beaches of a Pacific paradise, and the broad expanse of the Australian outback, these dogs followed their masters to the outposts of empires. Whether through good fortune or superior genetics, dogs from the A1a lineage traveled the globe and took root across the world. Now you find village dogs from this line frolicking on Polynesian beaches, hanging out in villages across the Americas, and scavenging throughout Old World settlements.

HAPLOTYPE: H1a.20

Part of the large A1a haplogroup, this haplotype occurs in village dogs throughout the world (outside of Asia). It is quite common in breed dogs, occurring frequently in Golden Retrievers, Irish Wolfhounds, Scottish Terriers, Border Collies, and Mastiffs.

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TRAITS

Coat Color

E Locus (Mask, Grizzle, Recessive Red)	**ee**
K Locus (Dominant Black)	**K^BK^B**
A Locus (Agouti, Sable)	**a^ta**
D Locus (Dilute, Blue, Fawn)	**DD**
B Locus (Brown, Chocolate, Liver, Red)	**BB**

Other Coat Traits

Furnishings / Improper Coat (RSPO2)	**II**
Long Haircoat (FGF5)	**TT**
Shedding (MC5R)	**CC**
Curly Coat (KRT71)	**CC**

Body Size

Body Size - IGF1	**NN**
Body Size - IGF1R	**GG**
Body Size - STC2	**TA**
Body Size - GHR (E195K)	**GA**
Body Size - GHR (P177L)	**CC**

Other Body Features

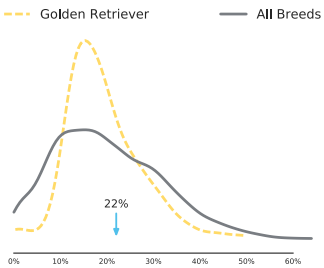
Brachycephaly (BMP3)	**CC**
Natural Bobtail (T)	**CC**
Hind Dewclaws (LMBR1)	**CC**

Performance

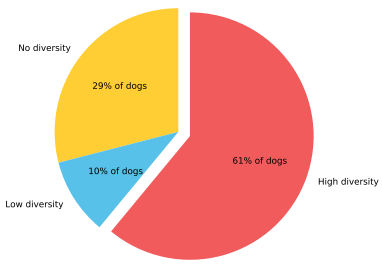
Altitude Adaptation (EPAS1)	**GG**

Genetic Diversity

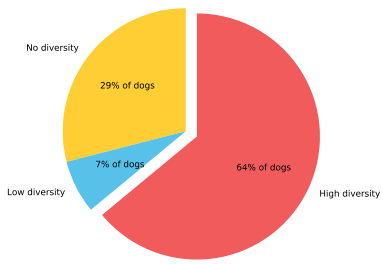
Inbreeding Coefficient **22%**



MHC Class II - DLA DRB1
High Diversity



MHC Class II - DLA DQA1 and DQB1
High Diversity



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TIMBER OF THE SHENANDOAH

CLINICAL TRAITS

These clinical genetic traits can inform clinical decisions and diagnoses. These traits do not predict a disease state or increased risk for disease. We currently assess one clinical trait: Alanine Aminotransferase Activity.

Alanine Aminotransferase Activity result: Low Normal

Timber of the Shenandoah has two copies of a mutation associated with reduced ALT activity. Please inform your veterinarian that Timber of the Shenandoah has this genotype, as ALT is often used as an indicator of liver health and Timber of the Shenandoah is likely to have a lower than average resting ALT activity. As such, an increase in Timber of the Shenandoah's ALT activity could be evidence of liver damage, even if it is within normal limits by standard ALT reference ranges.

More information on Alanine Aminotransferase Activity:
Known to be highly expressed in liver cells, activity levels of alanine aminotransferase, or ALT, is a common value on most blood chemistry panels and is known to be a sensitive measure of liver health. Dogs with two ancestral G alleles show "normal" activity. Dogs that have one or two copies of the derived A allele may have lower resting levels of ALT activity, known as "low normal". If your dog's result is "low normal" then when a blood chemistry panel is being interpreted the values that you and your veterinarian consider "normal" may need to be adjusted. Please note that neither a "normal" nor a "low normal" result for this predicts a disease state or increased risk for liver disease. Moreover, this mutation does not associate with increased levels of ALT: If your dog has high ALT levels, please consult your veterinarian.

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HEALTH

Good news! Timber of the Shenandoah did not test positive for any of the genetic diseases that Embark screens for.

0	0
AT RISK	CARRIER

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TIMBER OF THE SHENANDOAH

OTHER CONDITIONS

Good news! Timber of the Shenandoah tested clear for 9 genetic conditions that are common in his breed.

- Progressive Retinal Atrophy - prcd
  Progressive rod-cone degeneration (PRCD Exon 1)
- Neuronal Ceroid Lipofuscinosis
  (CLN5 Exon 4 Variant 2)
- Muscular Dystrophy
  Muscular Dystrophy (DMD Golden Retriever Variant)
- Dystrophic Epidermolysis Bullosa
  (COL7A1)
- Golden Retriever Progressive Retinal Atrophy 2
  (TTC8)
- Degenerative Myelopathy
  (SOD1A)
- Malignant Hyperthermia
  (RYR1)
- Ichthyosis
  (PNPLA1)
- Osteogenesis Imperfecta, Brittle Bone Disease
  (COL1A1)

TIMBER OF THE SHENANDOAH

FULL TEST PANEL

To help ensure healthy breeds, every test includes analysis of our full panel of over 160 genetic diseases.

Timber of the Shenandoah is also clear of 152 other genetic diseases that Embark tests for.