



## INTERPRETIVE GUIDE

Thank you for your purchase of the Pawsitive I.D.™ genotyping product. Your genotyping certificate is enclosed. This is your interpretive guide to understanding the DNA genetic results listed on the certificate. Pawsitive I.D.™ gives you genetic information about your pet. This information consists of DNA Fingerprinting for identification and parentage verification purposes, disease screening and color trait testing. Pawsitive I.D.™ uses the patent pending VeriSNP™ Universal Genetic Evaluation Process to determine all of its genetic markers. The following is your guide to understanding these results:

### **DNA FINGERPRINTING/PARENTAGE VERIFICATION**

The information in this category is your pet's unique DNA fingerprint. Use this information to positively identify your pet. The information presented is a string of letters (A,C,G,T) that represents components of genes at a certain chromosome location. This is a unique string of information that is almost impossible to duplicate in another animal. If you are a breeder and need to verify parentage of puppies/kittens you have for sale, you can use this information to verify parentage if you have previously obtained a DNA fingerprint of the mother & father.

Pawsitive I.D.™ will keep this DNA fingerprint information in a secure database and will make it available to owners who have their pets in the system if the pet ever becomes lost or legal ownership is ever in question.

- Q. What does the A,C,G,T stand for?
- A. The A,C,G,T are nucleotides that are detected by the SNP test and are critical components for the designated gene at the particular chromosome location
- Q. What does the CF (for dogs) or FC (for cats) and the number next to it mean?
- A. CF (for dogs) is Latin for Canis Familiaris and FC (for cats) is Latin for Felineus Cat. The number is the Chromosome location number.

### **DISEASE SCREENING**

Pawsitive I.D.™ can screen for the following inherent, genetic diseases:

#### **TEST # 1 MYOTONIA CONGENITA**

Myotonia congenita is a disease that is inherited as an autosomal recessive mutation in the canine chloride channel skeletal muscle gene. There are amino acid changes in the proteins of the muscle that affect the ability of the muscle to quickly relax after a voluntary contraction. The delay in skeletal muscle relaxation is not accompanied by cramping or pain to the animal. Affected dogs often have a rigid gate, probably due to excessive growth of the muscles. However, after exercise, the gate improves. The animals may also have an abnormal bark, and superfluous salivation with difficulty in swallowing. There is no known cure for the disorder.

**Commonly affected breeds include Miniature Schnauzer.**

#### **TEST # 2 PROGRESSIVE RETINAL ATROPHY**

Progressive retinal atrophy, or PRA as it is frequently termed, is a long recognized hereditary, blinding disorder. PRA is a disease of the retina. This tissue, located inside the back of the eye, contains specialized cells called photoreceptors that absorb the light focused on them by the eye's lens, and converts that light, through a series of chemical reactions into electrical nerve signals. The nerve signals from the retina are passed by the optic nerve to the brain where they are perceived as vision. The retinal photoreceptors are specialized into rods, for vision in dim light (night vision), and cones for vision in bright light (day and color vision). PRA usually affects the rods initially, and then cones in later stages of the disease. In human families, the diseases equivalent to PRA (in dogs) are termed retinitis pigmentosa.

**Commonly affected breeds include Cardigan Welsh Corgi, English Mastiff, Irish Setter and others.**

#### **TEST # 3 HYPOTHYROIDISM WITH GOITER**

Hypothyroidism refers to any state in which thyroid hormone production is below normal. There are many disorders that result in hypothyroidism. These disorders may directly or indirectly involve the thyroid gland. Because thyroid hormone affects growth, development, and many cellular processes, inadequate thyroid hormone has widespread consequences for the body.

**Commonly affected breeds include Toy Fox & Rat Terrier**

#### **TEST # 4                    CANINE LEUCOCYTE ADHESION DEFICIENCY**

Canine Leukocyte Adhesion Deficiency (CLAD) is an inherited abnormality of the immune system where the white blood cells are unable to fight infection. This disease was first identified in 1975 in Irish Setters. Several animals displaying various forms of recurrent infectious and immunological complications were found to have an aberrant expression of the CD18 molecule. The identification of the gene mutation responsible for the disease in Irish Setters was ascertained in mutational analysis of CD18 in Irish Setter CLAD pedigrees. From this, a single missense mutation was identified which showed complete association with CLAD in Irish Setters. This mutation is thought to be responsible for incomplete disulphide bonding within the  $\beta$ -integrin protein, causing defects in its function and hence impaired immune function.

**Commonly affected breeds include Irish Setters**

#### **TEST # 5                    NEURONAL CEROID LIPOFUSCINOSES**

Neuronal ceroid-lipofuscinoses (NCLs) are a class of inherited neurological disorders that have been diagnosed in dogs, humans, cats, sheep, goats, cynomolgus monkeys, cattle, horses, and lovebirds. NCL is almost always inherited as an autosomal recessive trait. In humans, mutations in one of at least six different genes can lead to NCL. Mutations in several other genes have been found to be responsible for NCL in one or more animal species.

**Commonly affected breeds include English Setters, Tibetan Terriers, American Bulldogs, Dachshunds, Polish Lowland Sheepdogs, Border Collies, Dalmatians, Miniature Schnauzers, Australian Shepherds, Australian Cattle Dogs, Golden Retrievers, and other breeds**

#### **TEST # 6                    CYSTINURIA**

Cystinuria is a disorder characterized by stones in the kidney, ureter, and bladder. It is caused by excessive excretion of certain amino acids (protein building blocks) due to genetic abnormality.

**Commonly affected breeds include the Newfoundland**

#### **TEST # 7                    NARCOLEPSY**

Narcolepsy is a chronic, neurologic sleep disorder characterized by uncontrollable sleep attacks, caused by excessive sleepiness. These sleep attacks usually occur multiple times a day even when an animal gets adequate sleep.

**Commonly affected breeds include Dachshunds**

#### **TEST# 8                    MUSCULAR DYSTROPHY**

Canine Muscular Dystrophy is a general term that refers to a large group of inherited and progressively debilitating muscle disorders characterized by degeneration of skeletal muscle. Clinical signs first appear at 6-9 weeks of age and include progressive weakness, stiff gait, muscle atrophy and contractures. Serum creatine kinase (CK) levels are markedly elevated and may be detected as early as 1-2 days of age. Characteristic morphologic lesions are present in muscle biopsies including muscle necrosis, phagocytosis, regeneration, hypertrophy, endomysial fibrosis and myofiber mineralization. Cardiomyopathy has consistently been present in X-linked MD and older dystrophic dogs may die of heart failure.

**Commonly affected breeds include Golden Retrievers**

#### **TEST # 9                    GLOBOID CELL LEUCODYSTROPHY**

Krabbe disease (also known as globoid cell leukodystrophy or galactosylceramide lipidosis) is a rare, often fatal degenerative disorder that affects the nervous system. This condition is inherited in an autosomal recessive pattern. Krabbe disease is caused by mutations in the GALC gene, which causes a deficiency of an enzyme called galactosylceramidase. The buildup of undigested fats affects the growth of the nerve's protective myelin sheath (the covering that insulates many nerves) and causes severe degeneration of mental and motor skills. As part of a group of disorders known as leukodystrophies, Krabbe disease results from the imperfect growth and development of myelin.

**Commonly affected breeds include West Highland & Cairn Terriers.**

#### **TEST # 10                  VON WILLEBRAND DISEASE**

Von Willebrand Disease (VWD) is a common bleeding disorder that dogs have. In fact, it is not a single disease, but a family of related diseases. All the different types are caused by a problem with the Von Willebrand Factor (VWF). This is a protein in blood which is necessary for proper blood coagulation, or clotting. When there is not enough VWF in the blood, or when it does not work the way it should, the blood takes longer to clot.

**Commonly affected breeds include German Shorthaired Pointers, Scottish Terriers, Dutch Kooiker, Doberman Pincher, Shetland Sheepdog, Manchester Terrier, Poodle**

#### **TEST # 11                  GM1 GANGLIOSIDOSIS**

GM1 gangliosidosis: A genetic lipid storage disorder that is similar in certain respects to Hurler syndrome and Tay-Sachs disease but which affects both the brain and the viscera (the internal organs). GM1 gangliosidosis causes skeletal deformities and exerts severe effects on the brain and internal organs. Death usually occurs by the age of 2. GM1 gangliosidosis is one of the classic lipid storage diseases. The gene responsible for it maps to chromosome 23 in the dog. There is no treatment for the disease. It is also known as familial neurovisceral lipidosis and Landing disease (after the pioneering pediatric pathologist Ben Landing).

**Commonly affected breeds include Portuguese Water Dog and Shiba**

#### **TEST # 12                  MUCOPOLYSACCHARIDOSIS TYPE VII (Dogs) & TYPE VI, VI MILD and VII (Cats)**

MPS VII is one of the least common forms of the mucopolysaccharidoses. The disorder is caused by deficiency of the enzyme beta-glucuronidase. In its rarest form MPS VII causes puppies to be born with hydrops fetalis, in which extreme amounts of fluid are retained in the body. Neurological symptoms may include mild to moderate mental retardation, communicating hydrocephalus, nerve entrapment, corneal clouding, and some loss of peripheral and night vision. Other symptoms include short stature, some skeletal irregularities, joint stiffness and restricted movement, and umbilical and/or inguinal hernias.

**Many breeds affected.**

### **TEST # 13 HEMOPHILIA B**

Hemophilia B is a hereditary blood coagulation disorder. It is caused by a deficiency of a blood plasma protein called factor IX that affects the clotting property of blood.

**Many breeds affected**

### **TEST # 14 PHOSPHOFRUCTOKINASE DEFICIENCY**

Phosphofructokinase Deficiency is a genetic disorder that interferes with the ability of muscles to use carbohydrates (such as glucose) for energy. It is also known as Tarui's Disease. A major symptom is muscle pain during intense exercise. This autosomal recessive disease is characterized by signs of discolored or darker urine, muscle weakness and cramps, anemia, and exercise intolerance. The term refers to similar disorders that appear in both humans and some other mammals, especially dogs.

**Commonly affected breeds include English Springer & Cocker Spaniels**

### **TEST # 15 SEVERE COMBINED IMMUNODEFICIENCY**

Severe combined immunodeficiency, or **SCID**, is a genetic disorder in which both "arms" (B cells and T cells) of the adaptive immune system are crippled, due to a defect in one of several possible genes. SCID is a severe form of heritable immunodeficiency.

**Commonly affected breeds include Bassett Hound, Jack Russell Terrier, Cardigan Welsh Terrier**

### **TEST # 16 THROMBASTHENIC THROMBOPATHIA**

Thrombopathia means a disorder of small blood cells called platelets or thrombocytes. Platelets play an important role at several stages of the body's response to any injury that causes bleeding. One function of platelets is to aggregate or "clump" at the site of blood vessel injury to form an initial plug. Platelets also facilitate blood clotting, in conjunction with the clotting factors, and release substances active in inflammation and tissue repair. In thrombasthenic thrombopathia, there is a reduction or absence of certain platelet membrane proteins that are necessary for normal platelet function.

**Commonly affected breeds include Otterhounds**

### **TEST # 17 CONE DEGENERATION**

CD disease causes day blindness due to degeneration of the retinal "cones" – cone-shaped cells in the retina that respond primarily to bright daylight. Between 8 and 12 weeks of age, when retinal development is normally completed in dogs, signs of vision problems are noticeable. The pups become day-blind and are photophobic – meaning that exposure to bright light is irritating or even painful. The pup will shun brightly-lit areas. Vision in dim light remains normal. The retina of the affected dog initially appears normal when examined by an ophthalmologist and initially the ERG (electroretinogram) recording is normal. However, the ERG response from the degenerating cones declines with age and is non-recordable in the mature CD-affected dog.

**Commonly affected breeds include the German Shorthaired Pointer**

### **TEST # 18 RETINAL DYSTROPHY**

A hereditary form of macular degeneration that results in progressive and irreversible visual loss. This disease is characterized by the appearance in early adulthood of small round white spots (drusen), particularly in the macula of the retina, which progress to form a honeycomb pattern.

**Commonly affected breeds include Briard**

### **POLYCYSTIC KIDNEY DISEASE (CATS ONLY)**

Polycystic disease is a disease that shows up later in life (late onset) with enlarged kidneys and kidney dysfunction occurring between three and 10 years of age (on average at seven years of age). The condition is inherited and cysts are present from birth, but are smaller in younger animals. Cyst size can vary from less than 1 mm to greater than 1 cm in size, with older animals having larger and more numerous cysts. Problems occur when these cysts start to grow and progressively enlarge the kidney, reducing the kidney's ability to function properly. The ultimate end is kidney failure. Some of the clinical signs are depression, lack of or reduced appetite, excessive thirst, excessive urination and weight loss. There is a marked difference in when and how quickly individual cats succumb, with the possibility of this developing late enough in life that the cat can die of other causes before kidney failure. However, kidney failure is certain when the cysts can grow and cause problems. Rarely, cysts are also seen in other organs such as the liver and uterus.

**Visit [Pawsitiveid.net](http://Pawsitiveid.net) for a full description of each of these diseases and check for newly added screenings.**

Your Pawsitive I.D.™ Genotyping certificate will show if your pet test either positive, otherwise known as "Affected" (Homozygous), Negative or is a Carrier (Heterozygous). Most of the time, pets test negative for these diseases. Obviously this result is a relief. Its also valuable information to know that your pet *DOES NOT* have one of these inherent, genetic diseases, particularly if you are a breeder.

Unfortunately there are cases where pets test positive (Homozygous). Your certificate will alert you to this. Please see you vet as soon as possible if this is the case. Your veterinarian can determine the extent of the problem and prescribe medication or therapy. This will keep you pet as comfortable as possible as long as possible.

In some cases test results indicate that your pet is a carrier (Heterozygous) of a certain disease. Your certificate will alert you to this condition as well. Being a carrier does not mean your pet has the disease but could pass these genes on to offspring. Depending on the disease and the breed, you should consider carefully if you should breed this animal. Please see you vet for additional treatment options and consultation.

### **PHYSICAL ATTRIBUTES**

Pawsitive I.D.™ can screen for the following color traits:

AGOUTI (AY)

YELLOW

MELANISTIC MASK

AGOUTI (a)

DILUTE COAT COLOR

(3) BROWNS

This information is typically more important to breeders where it can help determine coat color probability in future litters between two candidate animals. A very informative website which explains more about Physical Attributes and how the test results provided by Pawsitive I.D.™ could affect future characteristics of offspring from the tested animal is available at:

[www.homepage.usask.ca/~schmutz/dogcolors.html](http://www.homepage.usask.ca/~schmutz/dogcolors.html)

### **UNDERSTANDING THE RESULTS**

The results listed on your Certificate of Genotyping for Physical Attributes are explained below:

- Agouti** The alternation of light and dark bands of color in the fur of various animals, producing a grizzled appearance.
- Agouti Tests (AY)** Ay is a fawn or sable (with ranges from yellow to red with darker tips or the reddish hair of sable with intermixed black hairs).
- +/+ = ay/ay or homozygous for agouti ay  
+/- = ay/- or heterozygous carrier of ay  
-/- = -/- or negative for ay
- Agouti Tests (a)** **a** is the recessive black and is black in color.
- +/+ = a/a or homozygous for agouti a  
+/- = a/- or heterozygous for agouti a  
-/- = -/- or negative for **a**
- Melanistic Mask** Certain breeds of dogs that have a tan, yellow, fawn, or other pale coat color over most of their body may also have a black, brown or grey mask over their muzzle. This black muzzle can sometimes extend up over their ears. Breeds that have such a black mask include the Akita, Bullmastiff, Boxer, German Shepherd, Great Dane, Greyhound, Keeshound, Leonberger, Mastiff, Pekinese, Pug, Rhodesian Ridgeback, Sloughi, Tibetan Spaniel, and Whippet.
- +/+ = Em/Em or homozygous for Melanistic mask  
+/- = Em/- or heterozygous for Melanistic mask  
-/- = -/- or negative for Melanistic mask  
Em is positive for Melanistic mask
- Dilute Coat Color** **A coat color that appears lighter in intensity or paler than normal**
- +/+ = D/D or homozygous for dilution  
+/- = D/d or heterozygous for dilution  
-/- = d/d or negative for dilution
- D is positive for dilution. This dilution does not express in all breeds.  
There are other dilutions that are not yet mapped.
- Browns & Yellow** See Pawsitiveid.net for more information on BROWN & YELLOW color traits

- These color tests are not tested in all breeds at this time and are therefore not verified to be informative in all breeds.

**Visit [Pawsitiveid.net](http://Pawsitiveid.net) for a Glossary of common genetic terms**



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