



≈ COLORFUL ≈

# BACK TO BASICS

*The base colors—black, chestnut, bay, and brown—create the foundation for all other equine colors.*

By Laura Hornick Behning

Color is one of the most important characteristics that distinguish any horse, and it has had a profound effect on the Morgan breed. Selective breeding for dark color, bay in particular, has led to the proliferation of some colors, while others languished in obscurity—or, unfortunately, died out entirely. Color prejudices of the past are giving way to modern scientific knowledge of genetics, proving the old adage of, “A good horse is never a bad color.”

We are drawn to certain equine colors from an early age via books, television, and other influences. As a child, I wanted a black Morgan like the Breyer model I had, and a flaxen like the flaxen Morgan I saw at local 4-H shows. What horse lover doesn’t remember the colors of Secretariat, Mr. Ed, or Trigger? As one of the most visually appealing aspects of the horse, a particular color is often one of the first criteria on the Morgan shopper’s want list.

## GENETICS 101

As with all living things, a horse’s heritable characteristics (such as color) are encoded through a substance called DNA. DNA organizes this information into storage structures called chromosomes, which come in matched sets, one chromosome from each parent. The location of a gene on a chromosome is called its locus, and there are two possibilities at each gene locus. These possibilities, or alternate forms of a gene, are called alleles. An allele identified with a capital letter is a dominant trait and one identified with a lower-case letter is a recessive trait.

Sperm and ova contain only half the usual number of chromosomes, so each parent contributes one allele in each gene set to their offspring. When a horse has two copies of the same

allele, it is homozygous for that gene; if they are different alleles, it is heterozygous. This is true for every trait a horse has, not only color—though color is one of the most obvious!

For a recessive trait to be expressed, it must be in its homozygous form. However, a dominant trait—and it should be noted that most colors, with the exception of chestnut, are dominant—will be expressed whether it is heterozygous or homozygous. A horse that is homozygous for a certain allele will always pass it on to its offspring, while a horse that is heterozygous carries two different alleles and will pass on either one with a 50 percent chance each time.

A horse’s DNA makes up its genotype, which results in what is called phenotype, which is its appearance. With color, often a horse’s phenotype would lead one to believe it is actually something other than what its genotype proves it to be. This makes the study of equine color a fascinating subject—and one that is often full of surprises!

## TWO TYPES OF PIGMENT

In actuality, horses have just two colors, or pigment types: red and black. Red is familiar to horse people as chestnut, and black is, indeed, black. Whether a horse has red or black pigment is determined at the Extension (E) locus. Black (which is written in genetic test results as “E”) is dominant to red (which is written as “e”). This means that if a horse has at least one black gene—in other words, is “Ee” or “EE”, it will be black or a black based color, but it needs two red genes (“ee”) to be red or any red based color. It is sometimes helpful to think of it as black “covering” red.

There is a DNA test to determine what is going on at the Extension locus of a given horse. It is commonly called a “Red Factor” test because it determines whether or not a horse has the recessive form of

**ABOVE, LEFT TO RIGHT:** MtnTop Whippoorwill Tanek (Whippoorwill Talisman x Spring Lake Katefly) 2005 black stallion owned by Kristal Homoki and photographed by Laura Behning; Glenmorgan Benn Garnet (Glamorgan Damien x Alexandrite), 2012 chestnut (medium shade) stallion owned and photographed by Susen Fischer-Henkel (Germany).

BASE COLORS



BLACK



BROWN



CHESTNUT

**TOP TO BOTTOM:** Avondale Sweet Rose (Darkhawk Of Hideaway x Avondale Berne's Hope) is a 1994 black mare, owned and photographed by Laura Behning; Precision Made (UVM Prelude x Willy Remember Me) is a registered brown mare, owned and photographed by Laura Behning. In the Spring this mare appeared black with a tan muzzle, typical of browns. Sun fading resulted in more of a dark bay appearance later in the Summer; Spring Lake Thistle (Yankee's Anhingo x Southbrook Trophy's Summer) is a 2004 chestnut stallion owned by Niven Owings and photographed by Laura Behning. Thistle is the shade of chestnut commonly called red chestnut.

extension (“ee”). An “EE” horse is homozygous for black pigment, and will never produce a red offspring. So-called “homozygous blacks,” the shorthand for an “EE” horse, are very desirable in Morgan breeding circles. Interestingly, they might actually not even be a black appearing horse at all, for as we shall see, there are additional modifying genes that alter the black base color to bay, brown, black based dilutes (like buckskin or bay dun), various types of pinto, or gray.

BAY AND BROWN

So how is a bay or brown horse created? Bay and brown are actually an alteration of black through the addition of our first (and most common) modifier, Agouti. Agouti is sometimes called the “bay gene,” but it is more than just that. Agouti is dominant, so if a horse has at least one “A” it will be bay or brown. Agouti acts to restrict the black of the black horse to just the points—in other words, the mane, tail, and lower legs. This allows the red that is “uncovered” by agouti to show through on the body of the horse in varying degrees, depending on the type of Agouti present. In agouti’s recessive form (“aa”), any black pigment on the horse will cover the entire animal, making it black—if it has at least one “E” gene at the Extension locus.

Chestnuts carry agouti, but even if they have the dominant form (“AA” or “Aa”) it won’t show on them as they have no black hair to be restricted to the points. They can, of course, pass it on to their offspring. For example, a black x chestnut cross might produce a bay foal; this happened because the agouti, or bay gene, actually came from the chestnut parent, and the black base color necessary for the agouti to express came from the black parent. Black horses cannot have the dominant, “active” form of agouti, because if they did, they’d be bay and not black. Thus, all black horses are recessive “aa” at their Agouti locus.

There are thought to be three different types of agouti, but the currently available agouti test only tests for its presence or absence and does not differentiate between the various types. “A” is the Agouti which causes “regular” bay, a red body with black points; “A+” is the “wild type” Agouti, which results in a light bay horse with very little black on the legs, usually just around the fetlocks, and sometimes light hair in the mane and tail; and “At” is brown, or what is sometimes called “seal brown,” a nearly black horse with lighter, reddish gold areas on the muzzle and flanks. A horse will either have some combination of the three types, one of the three types plus one recessive agouti, or two recessive agoutis (“aa”).

Conventional theory is that there is an order of dominance amongst the various agoutis, with wild bay (the most restrictive of black) being dominant to bay, and bay being dominant to brown (the least restrictive of black). Two browns, for example, should not produce a bay. There have been examples of two bays producing a wild bay, however, so some now think that wild bay is caused by a separate modifier. This might also explain the relative rarity of the wild bay phenotype.

There is a lot of crossover in appearance between very dark bays and browns, and since there is no peer reviewed commercially available DNA test for brown at this time, it can be impossible to determine if a horse is genetically bay or brown. Visually speaking however, the darker shades of bay are considered to be brown. The Jockey Club uses a catchall phrase of “dark bay or brown” in their

## BASE COLORS



**BAY**



**WILD BAY**

## SHADE & OTHER MODIFIERS



**BLACK CHESTNUT**

**TOP TO BOTTOM:** Reminiscing (Applevale Commander x Oklahoma Glory), 1980 bay mare. This is a clear bay coloring, without any sootiness or dark shade. Owned and photographed by Laura Behning; UDM Milanne (Minion Millennium x Aljaks Miss Whamerica), 2010 wild bay mare owned and photographed by Karen Burridge. The black stockings on wild bays are less filled in than regular bays, with the black hair sometimes being limited to just the fetlock area. The lighter silvery hair in the mane and tail is another common feature of this unusual coloring; Marvelous Masterpiece (Marvelous Beginning x Marvelous Samantha) is a 1992 black chestnut stallion owned and photographed by Cheryl Yelle. Masterpiece looks almost black, but he is genetically chestnut. This unusually dark shade of chestnut is comparatively rare in the equine.

registration choices, which seem to cover all the bases.

Chestnut, bay, brown, and black makes up what are known as the base colors. The various dilution genes, pinto patterns, gray and interspersed white hairs such as roan and rabicano act on any of these base colors, effectively transforming them into what we commonly consider to be different colors. It is important to remember that they are still genetically either red or black based colors.

## SHADE AND OTHER MODIFIERS

Within each color there is a range from very light to very dark, and it is theorized that a genetic control called shade is one cause for this variation. Bays run the gamut of very light to very dark shades. The lighter shades of bay can even be mistaken for buckskin. Dark bays and browns can be confused with black; testing for Agouti will sort these out. The effect of shade on black is less obvious; some blacks are a very dark inky black and others a near liver color, but how much of this is simply the effect of sun exposure fading the color can be difficult to determine. Chestnut, especially in the Morgan breed, exhibits a striking variety of shades. At one time, AMHA even had a color designation of black chestnut in its registration choices. Black chestnut is not genetically separate from chestnut, but is rather the result of shade darkening the coat color to an almost-black coloring. Black chestnut is at the darkest end of the chestnut shade spectrum, with a very pale, almost palomino-like chestnut at the other end. Another chestnut variant has a darker mane and tail than the body and often a dorsal, leading some of these horses to be mistakenly identified as dun. “Tostado” is the South American term for these horses. Liver chestnuts, a very dark shade of red, are fairly common in the Morgan breed. Some are so dark that they might be mistaken for a dark bay, but a close inspection of the hair color right above the hoof gives a clue. Chestnuts will have red or cream colored hair on their fetlocks, while a black or dark bay will have black.

The other modifier that darkens whatever color it is present on is the sooty modifier. Sooty is a dark overlay generally most concentrated along the topline. When it is combined with lighter colors, like buckskin or palomino, it makes for a striking contrast and often vivid dappling. On darker horses, sooty is not as visible, as it blends in with the darker background color. Morgans are well known for their sooty colors, perhaps because of long selection for the darker colors in general.

Flaxen is a modifying gene that affects chestnut horses’ red manes and tails, turning them lighter than their body color. Some flaxen horses have silver-gray manes and tails instead of the more typical pale yellow or off-white shades of flaxen; this effect is thought to be caused by the sooty modifier acting on the flaxen hairs, effectively “dirtying” their color. Light flaxen chestnut horses can look similar to palomino, and dark flaxen chestnut horses can be mistaken for sooty palomino or silver dapple, but genetically speaking they are different. Flaxen “hides” on black based horses, as they do not have red manes and tails to show the effects of flaxen, but they can pass it on to their offspring. Not much is known about the inheritance of flaxen, but it is thought to be recessive.

Pangare, sometimes called mealy, is characterized by extremely light or golden areas in the muzzle, around the eyes,

## SHADE & OTHER MODIFIERS



DARK CHESTNUT



FLAXEN CHESTNUT



PANGARE MODIFIER ON FLAXEN CHESTNUT

**TOP TO BOTTOM:** GR Tequila Sunrise (Jingling Spurs LR x CHF Belle Starr) is a 2008 dark chestnut stallion owned and photographed by Kim Viker; Quietude Calais (Quietude Jubilee Kingdom x Quietude Paris), 2006 mare, is an example of a flaxen chestnut, owned by Lucy Ray and photographed by Laura Behning; By Starlight (Turfwood Royal Flush x Sunleaf's Sassafras), 1996 flaxen chestnut gelding owned and photographed by Jill Missler. This gelding is a very pale shade of chestnut, helped along by pangare—the pale areas on his underside and around his eyes and muzzle.

flank and undersides of the horse. It is a common modifier in such breeds as the Haflinger and Belgian, but less common in Morgans. The contrast of pangare with the darker body colors can be very striking. When pangare is present on lighter shades of chestnut or bay, the horse may be confused with palomino or buckskin. For some as yet unknown reason, pangare does not appear to affect black horses.

At this time there are no DNA tests available for shade, sooty, pangare, or flaxen.

## FOAL COLORING

As with all colors, foal coloring on bay, black, brown, and chestnut horses can vary from their adult color. Chestnut foals can be red like an adult or so pale as to appear dilute. Black foals can be inky black or a very light silvery shade. Bay foals typically do not have the black lower legs they will have as an adult, resulting in some being registered as chestnut instead of bay. However, young bay foals generally have a black mane and tail, black tips on the ears and black “triangles” of hair on the very back of the fetlock that indicate they are bay rather than chestnut. Some lighter or wild type bay foals can have a lot of red or light hair mixed into the mane and tail, further confusing the issue. If there is any doubt, testing for Red Factor and Agouti will settle the question of bay versus chestnut. Brown foals look more like an adult bay, with more black on the lower legs than bay foals, but some brown foals are a silvery gray like black foals can be.

All foals may have a dorsal stripe and leg barring similar to that found on duns, but this is not the dun gene at work, simply nature's camouflage for the young foal. The striping helps them to blend in when they are lying in tall grass, which aids in shielding them from predators.

Most young foals have pale lower legs and undersides. This can make it difficult to discern some white markings unless the foal is wet, or until after the foal sheds. By the time most foals are four or five months old they will have shed their foal coat and their color should be apparent. If in doubt about your foal's color, there are DNA tests for base color and all major modifiers, and it can be done at the time the foal is registered to conclusively determine the correct color.

## HISTORICAL DEVELOPMENT OF THE BASIC COLORS, AND THEIR SOURCES IN THE MORGAN BREED

Bay, or rather bay dun, was the original ancestral color of all horses, and bay dun horses can be seen in the earliest cave paintings. DNA testing on bones and teeth of horses that lived as far back as 35,000 years ago has showed them to be genetically bay. All of the other colors are the result of mutations in various genes, and even today, new colors are being discovered as mutations continue to occur. It should be noted that “mutation” does not, in this context, imply anything negative. It only indicates that the genes have had a permanent alteration in their sequence, resulting in a different color. Hair and eye color in humans are also examples of mutations with no harmful effects, and are simply a normal variation in DNA. Over time, similar mutations help to create genetic diversity, which

keeps populations healthy.

Black is a later mutation, and became more common in the horses of the Iberian Peninsula between 5500 and 4950 BC. The earliest DNA verified chestnut horse was a domestic Siberian horse from 3000 BC. Chestnut spread rapidly in the domestic horse population, with 28 percent of Bronze Age samples testing positive for the chestnut mutation.

It is interesting to note that the astute Morgan breeder can almost always make inferences about a horse's bloodlines based solely on its color! Some of our breed's most popular show and breeding horses of the last 75 years have been bay or brown, including Upwey Ben Don and Waseeka's Nocturne, two twentieth century stallions whose influence dominates the breed today. Bay is often viewed as the traditional Morgan color, especially since Justin Morgan was bay, and it is widespread in all families within the breed. Chestnut, particularly chestnuts with white markings, are also prominent in the breed via lines descended from old government breeding, especially some of the gaited families descended from Stellar, and current show lines such as Aljak's

Double Whammy and Minion Millennium. There are Lippitt families that are chestnut with white markings as well, such as those from Moro Hills bloodlines.

Flaxen is not uncommon in Morgans. Probably the most famous flaxens are those

prefix). Other well-known black Morgans of today descend from the Whipoorwill Morgans and related lines and owe their coloring to the Western working family stallion, Blackwood Correll.

While a breeder's top priority should always be type, conformation and temperament, the study of color genetics gives us an additional tool: the ability to predict what color(s) each cross can produce. Scientific research into equine color genetics has made it possible to determine, via DNA testing, exactly what base color a horse is, as well as identifying most modifiers. Armed with the facts, breeders can then make their selection for color—a benefit that is especially useful

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given the limitations imposed by the present economic climate. ■

**In next month's installment of this three-part series, we will examine the dilution genes present in the Morgan breed.**

*For more information about color in the Morgan breed, with numerous photo examples, please visit the Morgan Colors website at [www.morgancolors.com](http://www.morgancolors.com).*

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