EQUINE COAT COLORS AND GENETICS

By Erika Eckstrom

Crème Genetics

The cream gene is an incomplete dominant. Horse shows a diluted body color to pinkish-red, yellow-red, yellow or mouse gray. The crème gene works in an additive effect, making a horse carrying two copies of the gene more diluted towards a crème color than a horse with one copy of the gene. Crème genes dilute red coloration more easily than black.

No Crème Genes	One Crème Gene	Two Crème Genes
Black  A Black based horse with no "bay" gene, and no dilution gene, ranging from "true" black to brown in appearance.	Smokey Black  A Black horse that received one copy of the crème dilution gene from one of its parents, but probably looks no different than any other black or brown horse.	Smokey Crème  A Black horse that received one copy of the crème gene from both of its parents, possessing pink skin, blue eyes, and an orange or red cast to the entire hair coat.
Bay  A Black based horse with the "bay" Agouti gene, which restricts the black to the mane, tail and legs (also called black "points") and no dilution gene.	Buckskin  A Bay horse that received one copy of the crème dilution gene from its parents, giving it a diluted hair coat ranging in color from pale cream, gold or dark "smutty" color, and has black "points". Buckskins lack the dorsal strip associated with Duns.	Perlino  A Bay horse that received one copy of the crème gene from both of its parents, and has pink skin, blue eyes, a cream to white colored coat and a darker mane and tail (often orange or red tinted).
Sorrel/Chestnut  A Red based horse with no black gene and no dilution gene with black pigment in skin, but red pigment in hair.	Palomino  A sorrel/chestnut horse that received one copy of the crème dilution gene from its parents, giving it a coat ranging in color from pale cream, to golden, to chocolate and has a white mane and tail.	Cremello  A sorrel/chestnut horse that received one copy of the crème gene from both of its parents, and has pink skin, blue eyes, cream to nearly white hair coat, and a white mane and tail.

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Dun Genetics

Horse shows a diluted body color to pinkish-red, yellow-red, yellow or mouse gray and has dark points including dorsal stripe, shoulder stripe and leg barring.

Duns MUST have the following characteristics: Black or brown leg; The head will be darker than the body; Dark tips on the ears; A very DISTINCT dorsal stripe that runs fully from the base of the mane and into the tail. Duns will often have other characteristics such as: Stripes on the legs (leg bars); Mottling on the upper legs, shoulders, gaskins; Dark rings around the ears; Striping on the forehead (cobwebbing); Stripes crossing the back, shoulders, or neck.

This dun gene acts similarly to the crème gene in that it dilutes the base color, but not quite the same.

Black

A Black based horse with no "bay" gene, and no dilution gene, ranging from "true" black to brown in appearance.

Blue Dun, Mouse Dun or Grullo

A black horse with the dun gene. Grullos range in color from light silvery-white to dark chocolate brown, and some almost look black.

Bay

A Black based horse with the "bay" Agouti gene, which restricts the black to the mane, tail and legs (also called black "points") and no dilution gene.

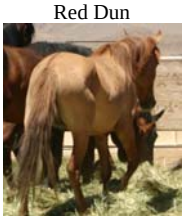
Classic Dun

A bay horse with the dun gene. Classic Duns are usually a yellow or tan color with dark points but can be as dark as a typical bay.

Sorrel/Chestnut

A Red based horse with no black gene and no dilution gene with black pigment in skin, but red pigment in hair.

Red Dun



A chestnut or sorrel horse with the dun gene. Red Duns are red in color and sometimes diluted to a very light red. The dorsal and dun marks are usually a dark, undiluted red color.

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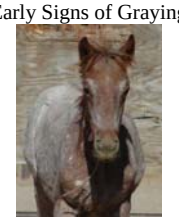
Gray Genetics

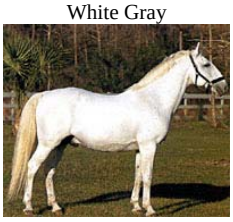
The gray gene (G) is an autosomal dominant gene.[1] A horse which has one copy of the gray gene, even if it has a gene for another coloring, will always become gray. Horses with the gray gene show progressive silvering with age to white or flea-bitten, but is born a non-gray color. Pigment is always present in skin and eyes at all stages of silvering. While gray is visually a distinct coat color, it is genetically a pattern that is imposed over other colors. Horses are not just 'gray'; they can be bay grays, cremello grays, silver grullo roan grays, etc.

Early Signs of Graying



Early graying signs: gray shows first around the eyes and backs of the ears. The face turns light, too, which is not seen on roans (which these foals are often mistaken for)

White Gray



A horses who has completed the graying process. All pigment in the hair, including that in his mane, tail and legs has been removed. The darkness of the muzzle is just the skin.

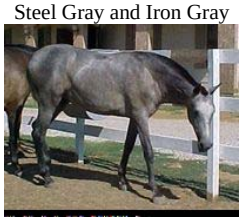
Rose Gray

Early Stage of Rose Gray

Mid Stage of Rose Gray

"Rose gray" describes the intermediate stage for horse born a chestnut or lighter bay color. While these colors "gray out," both red and white hairs are often mixed. Thus rose gray horses have a slight pinkish tinge to their graying coat. These horses are sometimes confused with roan, but unlike roan, gray continues to lighten with age.

Steel Gray and Iron Gray



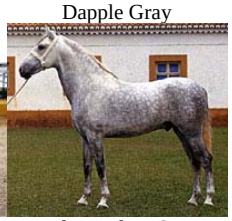
Steel Gray

An intermediate stage of turning gray in young black or dark bay horses is sometimes called "iron gray" or "steel gray." This coloring occurs when white and black hairs are intermingled. Iron and Steel greys are greys that do not go through the dappling phase as they grey, but rather are a pretty even mixture of white and dark hairs.

Gray Alleles

Dapple Gray

Early Dappling Stage



Mid Dappling Stage

Late Dappling Stage

Dapple greys are those that show circular variances in the distribution of color and gray hairs. Most horses don't stay this shade for long. Dappled grays should not be confused with slight dappling "bloom" seen on horses that are very healthy or slightly overweight, as "bloom" dapples disappear should the horse lose condition.

Fleabitten Gray

Fleabitten term describes horses that have small red or black (or both) dots on their body. Sometimes these dots occur only in certain areas and other times they cover the entire horse.On some horses fleabites occur as the horse progressively fades and on others they begin to show up after the horse has faded to the point of loosing all pigment.

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Alleles and Effects

	Alleles	Effect of combined pairs of alleles
Black Gene E	*E* *e*	***EE*** or ***Ee***: Horse forms black pigment in skin and hair. ***ee***: Horse is chestnut, it has black pigment in skin, but red hair pigment. White, gray, agouti, roaning, pattern (spotting) and dilution genes will all modify both red and black.
Fading and Non-Fading Black E+ also noted as Ed.	*E+* *e+*	A proposed theory, allele yet to be located, does not appear to occur on the same locus as the E and e alleles. ***E+E+***or ***E+e+***: Dominant black, non-fading horse. One theory, unproven and highly unlikely, is that E+ is dominant over agouti. ***e+e+***: no effect.
Agouti A	*A* *a*	Acts on "E" to restrict eumelanin, or black pigment, to "points," allowing red coat color to show on body. Has no visible effect on "e" or red, as there is no black pigment to restrict. ***AA*** or ***Aa*** horse is a Bay, black hair shows only in points pattern (usually mane, tail, legs, sometimes tips of ears). ***aa***: No agouti gene. If horse has E allele, then horse will be uniformly black.
Lethal White W	*W* *w*	***WW***: Lethal. Embryo reabsorbed or fetus dies *en utero*.[3] ***Ww***: Horse has pink skin and white hair, with blue or light-colored eyes. Hair coat is white from birth. ***ww***: Horse is fully pigmented.
Gray Gene G	*G* *g*	***GG*** or ***Gg***: Horse shows progressive silvering with age to white or flea-bitten, but is born a non-gray color. Pigment is always present in skin and eyes at all stages of silvering. Gray horses range from white to dark gray depending on age and the proportion of white hairs in the coat. Horses' coats gray in a manner similar to graying in human hair. ***gg***: Horse does not gray with aging.
Cream Gene Cr (UC Davis abbreviates as Cr and ***N***.)	*Cr* *C*	The cream gene is an incomplete dominant (additive effect). ***CC***: No dilution factor, horse is fully pigmented. ***CCr***: Single dilution factor (heterozygous dilute) results in Palomino, Buckskin or Smoky Black. Red pigment is diluted to gold with cream to white mane and tail; black pigment is not visibly altered on black points or black horses, though genetic testing can reveal "smoky black" coloration. ***CrCr*** Cremello or Perlino: Double dilution factor (homozygous dilute). Red pigment is diluted to a pale cream. Black pigment is diluted to a reddish shade. Skin and eye color are also diluted, skin is pink and blue eyes are common with double diluted creams.

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D	*D* *d*	**Dun Gene:** Another dilution gene. ***DD or Dd***: Horse shows a diluted body color to pinkish-red, yellow-red, yellow or mouse gray and has dark points including dorsal stripe, shoulder stripe and leg barring. ***dd***: Horse has undiluted coat color.
TO	*TO* *to*	**Tobiano**: a form of pinto patterning. ***TOTO*** or ***Toto***: Produces regular and distinct ovals or rounded patterns of white and color with a somewhat vertical orientation. White extends across the back, down the legs, but face and tail are usually dark. ***toto***: No tobiano pattern present.
O Also noted as Fr or FrO	*O* *o*	**Overo** or **Frame Overo** pattern ***OO*** or ***Oo***: Pinto horse pattern that forms a solid frame around white spotting. White is usually horizontal in orientation with jagged edges, color crosses the back and legs, face is often white. Overo as an allele is different from overo as a registration since the registration also includes the splash overo and sabino alleles. Homozygous overo is associated with lethal white syndrome, characterized by an incomplete colon and the inability to defecate, which leads to death or humane euthanization within days of birth. ***oo***: No overo pattern present.
Ch	*Ch* *ch*	**Champagne**: A rare but dominant dilution gene that creates pumpkin-colored freckled skin, amber, greenish, or blue eyes, and gives a bronze cast to hair. The skin surrounding the eye must be pink with freckles in adulthood. ***ChCh*** or ***Chch***: Champagne dilution evident (See Genetic Formulas Chart below.) ***chch***: No champagne dilution [4]
Prl	*Prl* *prl*	**Pearl**: A new rare recessive dilution gene that looks very much like Champagne. The Pearl gene is sometimes referred to as the "barlink factor." One dose of the mutation does not change the coat color of black, bay or chestnut horses. Two doses on a chestnut background produce a pale, uniform apricot color of body hair, mane and tail. Skin coloration is also pale. Pearl is known to interact with Cream dilution to produce pseudo-double Cream dilute phenotypes including pale skin and blue/green eyes. ***PrlPrl*** or ***Prlprl***: No pearl dilution. ***prlprl***: Pearl dilution evident. [5]
F	*F* *f*	**Flaxen**: Effects visible on red or chestnut colors only. ***FF*** or ***Ff***: Red points on ee horses. ***ff***: Flaxen points on ee horses. Proposed theory, allele not located.

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Pangare (Mealy) P	*P* *p*	Lightening of hairs in limited regions. The effects of this allele appear in areas of "soft" skin, including the muzzle, behind the elbows, in the flanks, on the buttock, above or around the eyes, and along the belly. ***PP*** or ***Pp***: Mealy or Pangare dilution of pigment. ***pp***: no mealy looking lightening of pigment. Proposed theory, allele not yet located
Roan Rn	*Rn* *rn*	***RnRn*** or ***Rnrn***: roan pattern of white hair mixed in with base color. There probably is no lethal roan question. ***rnrn***: No roan pattern.
Rabicano Rb	*Rb* *rb*	Partial roaning with 'coon' tail markings. Thought to be a dominant gene by Sponenberg. ***RbRb*** or ***Rbrb***: Rabicano markings. ***rbrb***: No rabicano traits.
Sabino Sb	*Sb* *sb*	Assorted pinto or roan-like markings. Sabino may be polygenic (a gene-complex rather than a single gene pair), caused by several different genes. Recognized by abundant white on the legs, belly spots or body spots that are can be flecked and roaned, chin spots, or white on the face extending past the eyes. Sabino is registered as overo by some registries, but is not the overo or frame overo allele. No risk of lethal white, though some "Fully expressed" sabinos may be completely white in coat color. ***SbSb*** or ***Sbsb***: Sabino markings. sbsb: No sabino markings. ***SB1***:The only Sabino gene currently detected by DNA testing, however does not appear to be the gene that creates sabino coloring in Arabians or Clydesdales.
Splash, Splashed White Spl	*Spl* *spl*	A type of pinto horse coloring recorded in the overo family, but possibly related to other genes. Resembles reverse tobiano with white moving from the bottom of the horse towards the top. The horse's head will look as if dunked in bucket of white paint. Commonly has blue eyes. ***SplSpl*** or ***Splspl***: Splashed markings. Splash is not associated with frame overo lethal white syndrome. ***splspl***: No splashed markings. Alternate theory: Incomplete dominant. ***SplSpl***:classic Splash markings.***Splspl***:socks, face markings, may be small in the "normal" marking range or into the pinto range with or without blue eyes. ***splspl*** causes no white at all.
Sooty Sty	*Sty* *sty*	***StySty*** or ***Stysty***: The Sooty effect of black hairs mixed into a body coat of another color, may create dark bays,"brown" horses and liver chestnut. Is most visible on Buckskin or Palomino. ***stysty***: No black mixed into coat. Proposed theory, allele not yet located.

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Silver Dapple Z	*Z* *z*	***ZZ*** or ***Zz***: Silver dapple - Dilutes eumelanin or black pigment. Converts black to brown with white mane and tail or results in silver coloring. ***zz***: No silver dapple.
Appaloosa or Leopard Lp	*Lp* *lp*	Appaloosa or Leopard spotting gene. Produces coat spotting patterns, mottling over otherwise dark skin, striped hooves and white sclera around the eye.

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Partial list of Genetic Formulas and Color Definitions

Chart based on Dr. Bowling's Genetic Formulas

W	White
G	Gray
E, A, CC, dd, gg, ww, toto	Bay or Brown
E, aa, CC, dd, gg, ww, toto	Black
ee, aa, CC, dd, gg, ww, toto	Red: Sorrel or Chestnut
E, A, CCr, dd, gg, ww, toto	Buckskin
ee, CCr, dd, gg, ww, toto	Palomino
ee, CrCr	Cremello
E, CrCr	Perlino
E, A, CC, D, gg, ww, toto	Yellow or "buckskin" Dun
E, aa, CC, D, gg, ww, toto	Mouse Dun, Blue Dun or Grulla
E,A,CC,D	Dun, "Zebra" Dun, "Bay" Dun, Classic Dun
ee, CC, D, gg, ww, toto	Red Dun
gg, E, aa, CC, dd, RN	Blue Roan
gg, E, A, CC, dd, RN	Bay Roan
gg, ee, CC, dd, RN	Red Roan
gg, E, A, CCr, dd, RN	Buckskin Roan (Red Roan)
gg, ee, CCr, dd, RN	Palomino Roan (Red Roan)
gg, E, A, CC, D, RN	Buckskin Roan (Red Roan)
gg, E, aa, CC, D, RN	Mouse Dun Roan, Grulla Roan, or Blue Roan&
gg,ee, CC, D, RN	Red Dun Roan (Red Roan)
gg, E, A, CC, dd, gg, ww, TO	Bay Tobiano
gg, ee, CC, D, gg, ww, TO	Red Dun Tobiano
gg, Ch, ee, aa, CC, dd, gg, ww, toto	Gold Champagne - looks like Palomino
gg, Ch, E, A, CC, dd, gg, ww, toto	Amber Champagne
gg, Ch, E, aa, CC, dd, gg, ww, toto	Classic Champagne
gg, Ch, ee, CcrCcr	Ivory Champagne
gg, E, aa, CC, dd, TO, Sb	Black Sabino-Tobiano (Tovero without lethal white.)
gg, E, aa, CC, dd, TO, O	Black Tobiano-Overo (Tovero carrying lethal white.)
ee, CCr, dd, gg, ww, TO	Palomino Tobiano Paint
gg, ee, aa, CC, dd, TO, Spl	Red Tobiano-Splash (Tovero without lethal white.)

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SIERRAS ALL THE GOLD

2002 Perlino Tobiano Paint Stallion
APHA 739,904
Homozygous Crème
Champagne Carrier

At stud at the Painted Barr Stables is Sierras All The Gold, a rare find that combines the Perlino Tobiano coloration with impeccable pedigree and a calm and kind temperament. Easy to ride, easy to handle, Sierra has been known to pass on his best traits to his offspring: color, conformation and personality.

With two blue eyes and homozygous crème genetics, Sierras All The Gold is a guaranteed color producer. His offspring are guaranteed to carry the highly coveted crème gene that gives horses their beautiful Palomino, Buckskin, Dun, Cremello and Perlino coloration. Sierra potentially carries the rarer Champagne gene. He will **NEVER** produce Sorrel, Chestnut, or Bay.

Bloodlines include: Hollywood Gold, Doc Bar, Jameen Tivio, Top Bracket, Lena Leo, Gay Bar King, Bill Cody, Leo Tag, Mr. Gunsmoke, Go Man Go, Man O' War, and more…

Please feel free to visit our webpage www.PaintedBarrStables.blogspot.com for more photos of Sierras All The Gold and his offspring, as well as current stud fees.

Genetics for Sierras All The Gold

Where homozygous genetics were unknown it was assumed heterozygous

CrCr Ee Aa TOto Chch ww gg oo rnrn

Crème
Black Carrier
Agouti (Bay)
Tobiano
Champagne
Non-Lethal White
Non-Grey
Non-Overo
Non-Roan

Crossed on Solid Chestnut:

75% Palomino, 25% Buckskin
50% Tobiano, 50% Solid
50% Champagne 50% Non-Champagne

Crossed on Solid Bay:

50-75% Bay, 25-50% Buckskin
50% Tobiano, 50% Solid
50% Champagne 50% Non-Champagne

Crossed on Heterozygous Tobiano:

75% Tobiano, 25% Solid

Guaranteed on Any Cross:

100% Crème Gene Carrier
0% Lethal White, Grey, Overo, Roan

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