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It's All in the Genes: Horse Traits and Heritability



Chestnut horses might be genetically wired to be more sensitive to environmental stimuli.

What are you drawn to in a horse? A flashy coat color? A puppy dog personality? Smooth-as-molasses gaits? Well, your dream horse didn't come by these traits by happenstance. Many characteristics such as coat color, height, athletic ability, and behavioral tendencies are genetic in nature. And researchers are using "genomics," the study of gene heritability, structure, and function, to determine which characteristics are connected to which genes.

First, let's break down the terminology. The genome includes all DNA that goes into an individual from sperm pairing with an egg. Every cell contains DNA in the form of chromosome pairs—except for gametes, or sex cells, which just have one chromosome.

Each strand of chromosomal DNA is made up of organic molecules

called nucleotides (guanine, cytosine, adenine, and thymine). Their sequence leads to differences in the traits the individual displays, such as coat colors.

Differences in the genomic DNA sequence between individual horses are called single nucleotide polymorphisms (SNPs, or "snips"). If SNPs are located near each other on a

chromosome, they will likely be inherited together; this proximity enables researchers to investigate specific regions of the genome that vary in frequency between horses.

Samantha Brooks, PhD, assistant professor and founder of the University of Florida's Brooks Equine Genetics Lab, in Gainesville, says SNPs aren't the only reason for genome variation. Much of it is also due to sequence rearrangements or changes. "Genes that have flipped or duplicated may be responsible for variation in phenotype (observable characteristics)," she says.

For instance, a sequence change is responsible for tobiano color (white hair on a base coat color) in pinto horses, says Brooks, who earned her doctoral degree from the University of Kentucky (UK) Department of Veterinary Science. While most rearrangements are benign, some are fatal, such as the overo lethal white gene responsible for a disease that suppresses intestinal activity.

Let's look at some of the harmless (and even desirable!) genetic variations that create horses' unique characteristics.

Coat Color's Link to Behavior

You've probably heard people describe chestnuts, or "redheads" as they're fondly called, as excitable and reactive. It turns out there might be some biological truth to this stereotype, says Brooks. In one study in

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humans, researchers compared pain responses in redheads to those of nonredheads. Subjects rated their pain in response to small electric shocks from electrodes attached to their shins. The researchers then administered an analgesic and asked the participants to rerate the pain. The redheads consistently perceived the electrical shocks as more painful than nonredheads did, but they reported relief from analgesia.

It turns out that both people and horses have mutations in the *MC1R* (melanocortin receptor 1) gene. This gene is responsible for signaling cells called melanocytes to produce the pigment melanin and establish base coat color. Redheads (both human and horse) have a variant of this gene that prevents them from producing the black pigment and allows them to produce only red pigments. In humans the *MC1R* loss-of-function mutation results in red hair, along with increased sensitivity to the sun and a lower pain tolerance. In horses, a similar mutation produces a chestnut coat color.

"The melanocortin receptors in the brain are in part responsible for translating a signal from that opioid class of chemicals (which the brain produces and uses for signaling), and the same receptors on melanocytes are responsible for receiving signals for when to turn black pigment on or off," Brooks explains. "This mutation in both chestnut horses and redheaded women creates a defective receptor that doesn't receive a signal for pigment control or for pain relief." This might make a chestnut-coated horse more sensitive to environmental stimuli.

Another base coat color gene, *ASIP* (agouti-signaling protein), is associated with behavior in horses. The *ASIP* gene works in the same signaling pathway to suppress the effect of the *MC1R* gene. Brooks and colleagues surveyed owners of 215 Tennessee Walking Horses to compare 20 temperament traits with DNA information extracted from the base of their hair follicles. Horses with a loss-of-function mutation in *ASIP*, which results in a black coat color, tended to have more self-reliant and independent tempera-

ments than bay horses. This particular mutation might also keep the adrenal gland from releasing natural steroid hormones in response to stress, thereby leading to a calmer temperament.

Spooking and the Startle Response

You've always known your spooky gelding is a bit of a scaredy-cat, but did you know he might be genetically wired to react to things the way he does? University of Florida researchers recently studied Quarter Horse weanlings to map the genes for spooking behavior.

"The initiation of a spook begins with a startle response, which is a neurologic reflex, not a conscious effort," Brooks says. "Some genetic changes result in



COURTESY DR. SAMANTHA BROOKS

Researchers are comparing weanlings' genetic makeup to their tendency to spook.

an alteration in the neurologic pathway controlling the startle response."

All study horses received uniform environmental training (e.g., they were halter-broke at the same time, etc.). All also experienced the same experimental setup: Once the weanlings were accustomed to being fed from a pan in a round pen, a researcher would pop open a brightly colored umbrella nearby while they ate. The team catalogued the responses—ear flick, increased heart rate, defecation, distance traveled, and the likelihood and speed of return to the feed pan. Some weanlings continued eating, some refused to return to the feed pan, and others exhibited behaviors across the spectrum. The researchers used a statistical model to score each individual's likelihood to spook.

"To map something, you must first be able to precisely measure it," says Brooks. Now the researchers will investigate each weanling's genetic makeup and look for genomic markers that correlate with its score.

"A practical objective of this work is

Masthead

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The Horse: Your Guide To Equine Health Care

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to create a genetic test for the tendency to spook, based on a population-wide average," says Brooks. "Recreational riders often want a quiet horse, whereas a show jumper may desire a horse with lightning-fast reflexes. A DNA sample submitted for genetic testing may help people decide if a young horse will be appropriate for their athletic endeavors."

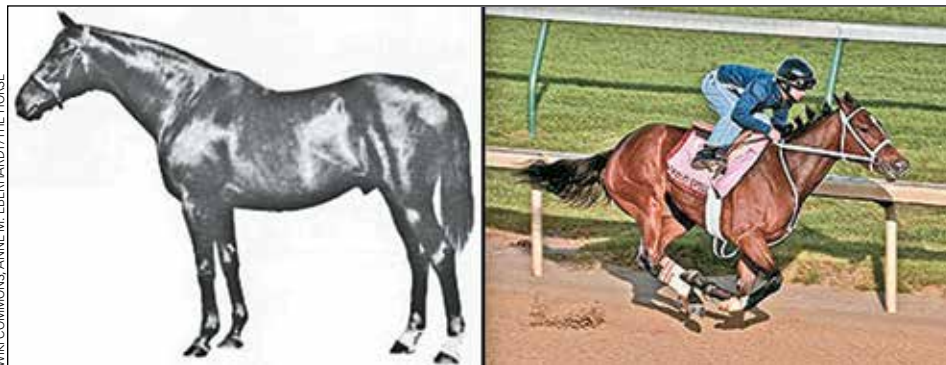
Along similar lines, Ann Staiger, MS, PhD, a recent graduate of Brooks' team, is conducting an ongoing experiment with Tennessee Walking Horses to map the genetics responsible for tractability and for willingness to load on a trailer.

Genes for Speed

Historically, breeders have had to rely on conformation and progeny performance records to predict a physical trait's heritability. Advances in technology and gene identification have led to the availability of tests that help determine if the sire and/or dam has actually passed on specific genetic markers for performance. With potentially better odds of acquiring a highly talented horse, there has been much interest in identifying genetic variables that impact racing performance.

Ernest Bailey, PhD, professor at UK's Maxwell H. Gluck Equine Research Center, in Lexington, is involved with The Horse Genome Project. He says several laboratories have investigated racing performance and the *MSTN* (myostatin) gene. They have identified two alleles (different forms of a gene at one chromosome location) on the *MSTN* gene—the T-allele for distance and the C-allele for sprinting. The T-variant is common in Arabian lines that produce successful endurance horses. In contrast, Quarter Horses have a high frequency of the C-allele for sprinting, whereas Thoroughbreds have a mix of the two.

Researchers have found that myostatin mutations are associated with increased muscling, distribution of fast-twitch muscle fibers, and hindquarter power. Practically applied, looking at pedigrees of Thoroughbreds that excel as 2-year-olds in elite middle-distance (8- to 12-furlong, with a furlong being 1/8 mile) races, common sires include great 20th-century stallion Nearco and his sons Nearctic, Nasrullah, and Royal Charger. All these horses' genes



WIKI COMMONS, ANNE M. EBERHARDT/THE HORSE

Nearco (left) is one of the common grandsires of elite racehorses, including Eclipse champion filly and 2008 Kentucky Oaks winner Proud Spell. He and his descendants carry the C-allele of the myostatin gene, which confers early muscling and speed.

contain the C-allele of the myostatin gene, which confers early muscling and speed in 2-year-olds. The myostatin gene profile can help predict an individual's best distance, but researchers caution not to consider it a speed gene or use it to define a horse's racing class.

The Genes Behind Gaiting

Gaited horses rely on the "gait-keeper mutation," *DMRT3_SER301STOP*, to maintain their gaiting at high speed without breaking into a canter. Horses with this mutation tend to use intermediate (i.e., trotting or pacing) gaits more frequently, says Brooks.

"Racing performance and gait are much more complex than can be explained by a single gene, but this gene has a major impact on gait," says Bailey.

In a 2014 evaluation of breeds worldwide, Swedish researchers found this mutation in 68 of 141 breeds. It was most common among gaited breeds or harness racing horses and often absent in other breeds. Bailey says selection for it has enabled its spread in Standardbreds, Saddlebreds, Missouri Fox Trotters, Paso Finos, Icelandic horses, and Kentucky Mountain Saddle horses, to name a few.

Height's Link to "Roaring"

Researchers have noted a positive correlation between Thoroughbred racehorse height (and leg length) with earnings. But breeding pressure to instill the "tall" gene might have created unintended consequences. Scientists have now identified a link between height and the respiratory condition recurrent laryngeal neuropathy (RLN, or "roaring") in Thoroughbred racehorses and in draft horses. In a 2014 study out of Michigan State University,

the authors demonstrated "a significant association of RLN with the *LCORL/NCAPG* locus (the position of a gene on a chromosome) on equine chromosome 3 previously shown to affect body size in horses." This same location is known to have a significant effect on Thoroughbred withers height.

"Genes are strung along the chromosome like pearls on a necklace," says Brooks, reflecting on SNP proximity. "Those that are nearby to one another will tend to stay together and aren't often separated by the process of recombination," which produces offspring with combinations of traits different from those found in either parent.

"If selective breeding increases the frequency of the tall gene, and if it sits on the same chromosome as the neuron-affecting gene, then there may be a simultaneous increase in both frequency of height and for a disease like roaring," she says.

More research is needed to determine the RLN and height genes' actual proximity or if they are the same gene performing two unique functions, says Brooks.

Take-Home Message

Genomic science can help breeders decipher a horse's potential appearance and performance qualities. These are only a few of the current projects geneticists are working on involving equine athletic ability, coat color, and behavior.

Similar work on other species lays a foundation to select and test for particular equine ability and behavior profiles that best suit a rider's pursuits. **UK**

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Racehorse Breakdowns: The Importance of Post-Mortem Exams



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More than 80% of horses that suffer a fatal musculoskeletal injury have pre-existing underlying pathology related to the fracture, indicating that the final catastrophic event is the culmination of repetitive wear and not an isolated incident caused by a “bad step.”

I often answer the question, “Why would someone want a post-mortem exam on an animal?”

As a veterinary pathologist involved in a necropsy program for racehorses that have sustained injuries on the racetrack, I get much the same question from both lay people and professionals in the horse industry.

Most people understand why a post-mortem is warranted in a case of sudden death but understanding the need for a necropsy on a horse that has sustained a catastrophic musculoskeletal injury might be less clear. Like all athletes, Thoroughbred racehorses experience a consistent pattern of repetitive use wear associated with their musculoskeletal systems. An analogy familiar to most is the term “tennis elbow.” Likewise, “Tommy John” surgery for baseball pitchers is a commonly recognized term, as rotator cuff injuries also are a familiar malady in quarterbacks.

The association between pre-existing lesions and catastrophic injuries has been documented for many years, beginning with the flagship post-mortem program instituted in California. More than 80% of racehorses that suffer a fatal musculoskeletal injury have pre-existing underlying pathology related to the fracture, indicating that the final

catastrophic event is the culmination of repetitive wear and not an isolated incident caused by a “bad step” or a “hole in the track.” By carefully examining the horse, the pathologist can document the acute, catastrophic injury as well as the underlying pathology. Additionally, he or she can note nonmusculoskeletal health issues.

Mortality reviews are conducted with the trainers, the equine medical director, and the stewards following catastrophic breakdowns. The goal of these reviews is not to place blame, but to educate and implement strategies to prevent similar injuries going forward. The horse’s overall health and condition, his training and racing records, and the post-mortem exam outcome are reviewed in the hope of identifying risk factors for that particular horse and opportunities for future intervention.

Additionally, it is hoped that the trainer will disseminate the knowledge gained by sharing their experience with others, including those who work in their barn, friends, and colleagues. Health issues that might not have been clinically apparent but are identified on post-mortem examination can be addressed, with informative conversations regarding such things as exercise-induced pulmonary hemorrhage and gastric ulcers. In a very complicated

set of circumstances, the post-mortem examination brings objectivity to these observations.

The ultimate goal of any post-mortem program is to mitigate the horse’s injury risk and, in turn, the exercise riders and jockeys that are involved. Catastrophic breakdowns are the leading cause of serious injury to riders, and in some tragic cases, death. While post-mortem examinations might be “too late” for the horse in question, the value to the entire population of racehorses and to the connections of a particular horse are invaluable. We owe it to the horses, riders, trainers, and the racing community as a whole to address this issue. Breakdowns are not inevitable events. We can mitigate the risk of their occurrence in racehorses through careful and determined study. **UK**

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Deworming Horses: Dealing With Differing Opinions

Q My senior gelding is out for a lease trial. At home he lives in a drylot, and his fecal egg counts always show him to be a 0 shedder, so I treat him twice a year with a product that includes praziquantel for tapeworms.



ALEXANDRA BECKSTETT/THE HORSE

Keeping pastures and paddocks free of manure can help reduce the number of anthelmintic treatments horses require.

Deworming Horses

The barn he is moving to is impeccably clean and has excellent manure management. There, he will get turnout time in shared grass paddocks. However, this farm does not do fecal egg counts and still uses an eight-week rotational program on all the horses. I tried to explain the current recommendations for parasite control to the owner but to no avail.

Our agreement is that I will manage my horse's parasite program separate from the farm's. But I'm concerned that he is at risk because of the barn's practices, although I'm happy there is never manure left on the paddocks. Should I be concerned, and what's the best way to protect him from internal parasites while he lives there?

—Ashley, via e-mail

A Thank you for your question. Your situation is not unusual at all. We recently published results from a U.S.-wide survey showing that a large proportion of horse owners do not follow the current recommendations. So, this barn manager is definitely not alone in her management techniques. This begs the question: What are we (the researchers) doing wrong in communicating our recommendations? But that is a topic for another day.

With regard to your horse, let's get a few things straight. If the pasture and paddock hygiene is really as good as you describe, very few, if any, anthelmintic treatments will be necessary. Treating six times a year on a rotational schedule is asking for drug-resistant—probably multi-drug-resistant—parasites. So, the horses are unlikely to benefit much from the six yearly treatments; instead, the pasture hygiene may be effective at keeping parasites in check. And finally, parasite control must be carried out on the herd level.

There are some common misconceptions regarding that last point. As owners, we tend to think about what we can do for our horses. But parasite control requires a coordinated effort for the whole population of horses—we're aiming to control a parasite population present on the pasture and paddocks shared by all the horses. Therefore, you cannot define one program for one horse and another for the remainder. This is often very challenging, as your example illustrates perfectly well, and I realize you've probably already tried discussing these items with the barn manager.

With all that said, my assessment of your situation is that your horse is unlikely to be exposed to a high parasite infection pressure. You didn't mention anything about stocking density and age distribution of the horses present, so I can't say for sure, but the cleanliness of the farm suggests a low pressure.

However, the parasites at the facility are likely multi-drug-resistant, and your horse will likely acquire these parasites. We do not know the actual resistance profile without fecal egg counts being done so we can only guess, but resistance to two or all three dewormer classes (benzimidazoles [including fenbendazole], pyrimidines [pyrantel], and macrocyclic lactones [including ivermectin and moxidectin]) is very likely.

You did not say how old your horse is, but some older horses tend to have higher egg counts in general, which suggests they may be more susceptible to infection. A horse that recently moved to a new facility is also likely to have a higher egg count for a while until he is settled into the new environment.



Streptococcus equi

This month's featured map is *Streptococcus equi* subspecies *equi* (*S. equi*), the causative agent of strangles.

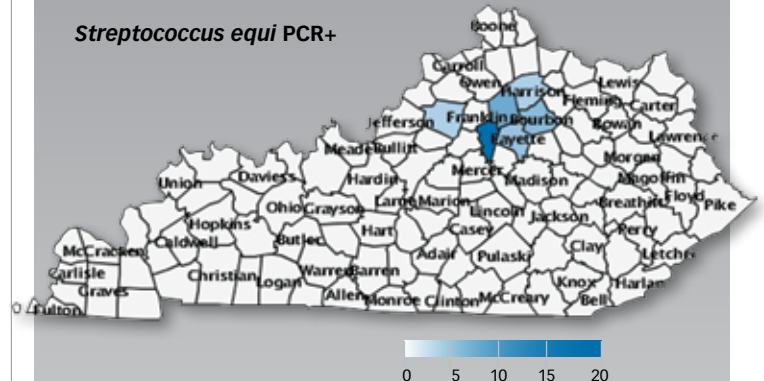
This contagious upper respiratory disease causes inflamed lymph nodes in the upper airway and trachea. Clinical signs include nasal discharge from the abscessed lymph nodes draining externally or into the guttural pouches (blind-end sacs connected to the throat in horses).

As of June 18, the UKVDL has seen seven cases in June and saw 17 cases in May.

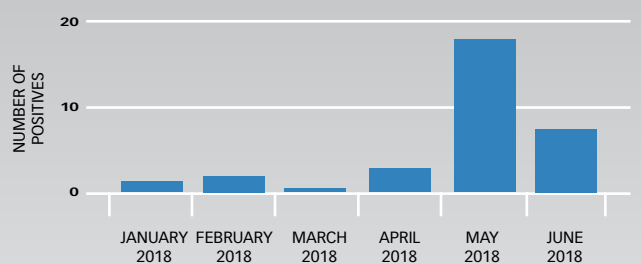
Individuals with questions or concerns about disease outbreaks can contact the UKVDL at 859/257-8283. [UK](#)

>Jacqueline Smith, PhD, MSc, BSc, Dipl. AVES, UKVDL epidemiologist and adjunct professor of epidemiology at Lincoln Memorial University, is the founder of the UKVDL Disease Mapping Initiative, a database designed to record all infectious disease cases submitted to the UKVDL.

Streptococcus equi PCR+



MONTHLY TRENDS



See each month's featured map at vdl.uky.edu/FeaturedMap

Deworming Horses

All horses have parasites, but parasitic disease is extremely rare. So, your horse will likely get some resistant worms, but the risk of disease is very low.

Regarding your question about what you can do to protect him, unfortunately, there really isn't much. You can test

your horse pre-and post-deworming to ensure good effectiveness but remember that no dewormer completely eliminates all parasites present.

Finally, you can tell the barn owner that she is wasting her money on dewormers that don't do anything for the horses. At least four out of the six yearly treatments are likely to be ineffective, and even the cheapest dewormer is very

expensive if you use it repeatedly and it doesn't work. So, in reality, those horses also get two treatments a year, just like yours. Why not skip the other four? **UK**

>Martin Nielsen, DVM, PhD, Dipl. EVPC, ACVM, is an associate professor of parasitology and the Schlaikjer professor in equine infectious disease at the Gluck Equine Research Center, in Lexington.

Cutaneous Lymphangitis in Horses

The lymphatic system is an important component of the cardiovascular system and consists of lymphatic vessels, lymph nodes, tonsils, spleen, and thymus. Lymph, a clear colorless fluid, is formed from fluid loss that occurs during normal nutrient exchange in capillary beds. The lymphatic vessels transport lymph to regional lymph nodes for filtration to aid in immunologic detection of microorganisms, toxins, and foreign material. Once filtered, the vessels once again transport the lymph to large veins, which ultimately return it back into the circulatory system to replenish the fluid lost from the capillaries.

Lymphatic disease can occur when lymph vessels become inflamed, leaky, and/or blocked. Cutaneous lymphangitis—inflammation of the skin's lymphatic vessels—is fairly uncommon in horses, does not exhibit age, sex, or breed predilections. It can develop from both infectious and non-infectious causes. Clinically, cutaneous lymphangitis in horses can manifest as a swollen limb, skin abnormalities characterized as multiple skin nodules that can abscess or develop draining tracts, and/or lameness. Cutaneous lymphangitis typically affects the distal (lower) portion of a single hind limb, between the hock and hoof. Due to the characteristic appearance of affected limbs, the disease is commonly referred to as “big leg” or “fat leg.”

Infectious cutaneous lymphangitis in horses has traditionally been associated with poor hygiene and microorganisms transmitted via insects. It is sporadically diagnosed in horses, but sometimes occurs simultaneously in multiple horses on the same farm. Infection of the lymphatic system develops following contamination of skin wounds by

various bacteria, most commonly *Corynebacterium pseudotuberculosis* (the causative agent of ulcerative lymphangitis/pigeon fever). However, pure or mixed infections with other bacteria, such as *Staphylococcus* spp, *Streptococcus* spp, *Trueperella pyogenes*, *Rhodococcus equi*, *Pasteurella haemolytica*, *Pseudomonas aeruginosa*, *Fusobacterium necrophorum*, *Actinobacillus equuli*,



COURTESY DR. KENNON KECKLER

Due to the characteristic appearance of affected limbs, cutaneous lymphangitis is commonly referred to as “big leg” or “fat leg.”

and *Burkholderia mallei* (the cause of glanders) can also result in cutaneous lymphangitis. Additionally, pathogenic fungi such as *Sporothrix* spp (the cause of sporothricosis) or *Histoplasma farciminosum* (the cause of epizootic lymphangitis) also have been associated with lymphatic system infection. The U.S. is currently free from glanders and epizootic lymphangitis.

Treatment of infectious cutaneous lymphangitis in horses includes appropriate antimicrobials, non-steroidal anti-inflammatory drugs, hydrotherapy, and surgical fluid drainage. Cutaneous lymphangitis can become chronic if left untreated or if treatment is ineffective. Chronic expansion of the subcutis by edematous fluid due to faulty lymphatic vessels can result in the deposition of fibrous tissue and permanent limb disfigurement. This emphasizes the importance of rapid diagnosis and treatment of cutaneous lymphangitis.

Sporadic lymphangitis, also known as “Monday morning leg,” can also result in swollen distal hind limbs. This condition can develop in horses that are stabled or immobile for extended lengths of time, typically days or more. The cause of sporadic lymphangitis in horses is not well understood, but luckily the condition typically resolves after exercise.

Cutaneous lymphangitis is occasionally diagnosed at the UKVDL. However, the exact frequency of the condition cannot be easily estimated through typical diagnostic submissions, because diagnoses are frequently made by veterinarians in the field and don't require extensive diagnostic evaluations. **UK**

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Two PHF Cases Confirmed in Kentucky Horses in June

Kentucky animal health officials reported the commonwealth's first cases of Potomac horse fever (PHF) for 2018 this month. Both cases were confirmed in Thoroughbred fillies from Bourbon County.

E.S. "Rusty" Ford, equine operations consultant for the Kentucky State Veterinarian's Office, said in a statement that a 4-year-old filly presented June 1 with profuse watery diarrhea, lethargy, and a fever of about 104°F. The filly was isolated at a hospital, and PCR testing

confirmed the PHF diagnosis on June 4.

"Following treatment, the symptoms began resolving," Ford said. "This morning (June 4) the patient is described as being significantly improved with a favorable prognosis."

Then, on June 5, Ford said a yearling filly presented beginning May 29 with acute watery diarrhea, dehydration, and fever. Following disease confirmation via PCR the filly began treatment.

"On Tuesday, June 5, the filly appeared much improved and is expected to make a full recovery," he said.

Although both positive cases came from Bourbon County, Ford said "findings of our epidemiologic investigations support our conclusion of there being no direct correlation or relationship between these two cases."

Potomac horse fever is caused



Horses are exposed to PHF's causative agent by inadvertently ingesting aquatic insects infected with flukes carrying the bacteria.

by *Neorickettsia risticii*, an organism found in some flukes (a wormlike parasite) that infect aquatic snails and insects (such as caddisflies and mayflies). Horses can be exposed by inadvertently ingesting aquatic insects infected with flukes carrying the bacteria or by drinking flukes directly from rivers or streams. Even horses residing far from water bodies aren't out of PHF's reach, as vectors can be attracted to barn and stall lights and inadvertently end up in horses' feed or water sources.

Initial clinical signs include anorexia, lethargy, and fever, followed by enterocolitis, dehydration, and diarrhea. This could progress to toxic shock, laminitis, or death (30% mortality rate). The disease can also cause abortion in pregnant mares and endotoxemia.

"Historically, it is a bit later in the year when we begin recognizing PHF in Central Kentucky and believe the early detection this year is likely a result of the unusual climatic conditions we experienced these past eight weeks that include abundant rainfall during the month of April and continued with record-breaking heat temperatures throughout May," Ford said.

"Horsemen are encouraged to review the environment their horses are housed in and consult their veterinarians on strategies they may use to mitigate disease risk," he added. "Minimizing insect ingestion in stabled horses by turning off barn lights at night, which normally attract the insects, has been suggested."

Keep tabs on confirmed PHF cases in Kentucky horses with the UKVDL's Animal Disease & Diagnosis Mapping Initiative at vdl.uky.edu/EpidemiologyInformation/EquineMaps/PotomacHorseFever.aspx. **UK**

>Erica Larson is the news editor for *The Horse*.

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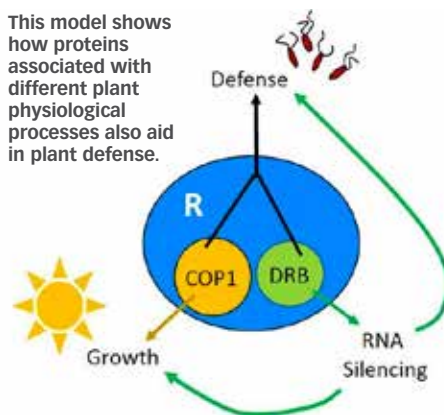
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Researchers Find Connection Between Plant Defense and Development

Scientists in the UK College of Agriculture, Food and Environment recently found that a cellular protein involved in plant growth is also important for signaling defense against disease-causing microbes. This finding is important for scientists as they continue to better understand the trade-offs between pathogen defense and growth in plants.

“Traditionally, growth and defense have been studied separately, not just due to the complex nature of these physiologies but also because many of the regulating components were considered exclusive to one or the other pathway,” said UK plant pathology researcher Pradeep Kachroo, MS, PhD. “Our research ties these processes and the RNA silencing pathway together

This model shows how proteins associated with different plant physiological processes also aid in plant defense.



and shows that they regulate each other.”

Kachroo; Aardra Kachroo, MS, PhD, also a plant pathology researcher at UK; and collaborators from Washington and France found that the COP1 protein, a well-known repressor of photomorphogenesis (growth and development in response to light), also regulates pathogen defense. In the dark, COP1 helps recycle key proteins that stimulate light-dependent growth, thus helping conserve energy.

The researchers found that COP1 recycles proteins involved in plants’ RNA-silencing machinery. The RNA-silencing proteins, in turn, regulate plant resistance proteins. Because COP1 and the RNA-silencing proteins work together to help trigger resistance, if one of them is not present, defense is not activated, and plants succumb to disease.

“COP1 stops growth and lets resistance happen when there’s a need for defense,” said Aardra Kachroo. “This is important because pathogen defense is an energy intensive process. Thus, COP1 acts kind of like a switch between growth and defense.”

These findings will help scientists design better strategies to combat agriculturally important microbial diseases with fewer repercussions to yield.

The study was funded by the National Science Foundation’s Division Integrative Organismal Systems and recently published in *PLoS Pathogens*. [UK](#)

>Katie Pratt is an agricultural communications specialist within the UK College of Agriculture, Food and Environment.

Mineral of the Month: Cobalt

Most of us will recognize bold cobalt blue, a common part of modern artists’ paint collections. This isn’t a new idea, however. In ancient times, artisans used the mineral cobalt (Co) to color glass, particularly that used in ancient Egyptian and Persian jewelry. Chinese artists also used it to produce blue pottery glazes. In 1730, a chemist determined that undesirable blue ores sometimes encountered in copper were actually the result of an unknown metal; the chemist dubbed this metal “kobalt,” a German term used by miners meaning goblin.

Cobalt’s presence in plant material was established well before it was found in animal tissues. However, the low concentrations at which Co appeared in animal tissues led to the conclusion

that it was not biologically important. It wasn’t until 1935 that researchers showed that Co was an essential part of cattle and sheep diets. In those species low Co intakes were associated with “wasting disease,” which, as it were, was particularly prevalent in ruminants grazing areas known to be Co-deficient. However, horses grazing these same areas reportedly did not show signs suggesting a Co deficiency, indicating that horses’ dietary requirements were being met by these same forages.

Today we know Co is an essential part of vitamin B12, which plays a role in the amino acid and fatty acid metabolism as well as nervous system function, making it an important part of the equine diet. However, similar to the earlier observations, Co (or vitamin B12, for that matter) deficiency has never been reported in



Commonly fed feedstuffs appear to be capable of meeting horses’ Co requirements.

horses. As such, it appears that commonly fed feedstuffs are capable of meeting horses’ Co requirements.

The National Research Council’s *Nutrient Requirements of Horses* (2007) sets the current recommended daily Co intake for a mature horse (weighing 500 kilograms or 1,100 pounds) at rest or used for light exercise at 0.5 milligrams (mg) Co per day. This level increases to 0.6 mg per day for horses of similar weight used for

more intense exercise or lactating broodmares.

Although typical feedstuffs can meet the horse’s Co requirements, Co supplements are available. Before adding a Co supplement to your horse’s diet, consult an equine nutritionist to determine if additional Co could benefit your horse. [UK](#)

>Mieke Holder, PhD, is an assistant research professor within the UK Department of Animal and Food Sciences.

Genetic Testing at Gluck Ends Blood Typing, Continues DNA Testing

Genetic Testing at Gluck at UK recently ended its equine blood-type testing. The laboratory continues to offer DNA testing.

Kathryn Graves, PhD, Genetic Testing at Gluck director, said the lab elected to cease blood-type testing for a number of reasons, including the age of the necessary equipment and the technical time required to perform testing. The lab had offered the test since its inception in 1986; however, DNA verification replaced blood typing for equine parentage verification in 2001. Genetic Testing at Gluck continued to offer blood typing to facilitate registration of horses whose parents were deceased and did not have DNA profiles on record and was the last laboratory to offer full blood typing services.

In addition, the lab will no longer offer neonatal isoerythrolysis antibody testing, which is available from several other veterinary laboratories in the Lexington area.

"Over the years we had to decrease the number of systems we tested for as equipment has failed," Graves said. "Difficulty in finding parts for the computer running the DOS program

used to record red cell readings was another factor."

Graves said DNA testing is still available to generate DNA types and perform parentage testing. The laboratory uses a panel of 17 microsatellite markers for standard testing. In addition to DNA testing, the laboratory also offers testing for:

Disease mutations:

- Dwarfism in Friesians and Miniature Horses;
- Equine arteritis virus, to determine CXCL16 haplotype;
- Foal immunodeficiency syndrome;
- Hydrocephaly in Friesians;
- Junctional epidermolysis bullosa in American Saddlebreds;
- Overo lethal white syndrome;
- Myotonia; and
- Warmblood fragile foal syndrome.

Colors:

- Agouti gene;
- Champagne;
- Cream (dilution) gene;
- E locus (red gene);
- Gray;
- Sabino;
- Silver dapple (Z); and
- Tobiano.

Learn more about DNA testing and the other tests offered at getgluck.ca.uky.edu. **UK**

>Jenny Evans, MFA, PhD candidate, is the senior veterinary science marketing/promotion specialist at the UK Gluck Equine Research Center.



Summer Heat Can Stress Farm Animals

Even before summer officially began Mother Nature brought heat and humidity to the Bluegrass. Kentucky experienced its warmest May on record, and our livestock are feeling it.

"When you get a combination of heat and humidity, it can cause concern for livestock," said Matthew Dixon, UK College of Agriculture, Food and Environment agricultural meteorologist. "We go by what is called a 'livestock heat stress index' to determine what level of concern farmers and pet owners need to have for their animals."

The index helps producers know when heat stress could be problematic for animals so they can be even more vigilant in making sure animals have the necessary resources to combat and withstand the conditions.

"The most important thing producers can do is provide cool, clean water and shade," said Jeff Lehmkuhler, PhD, UK beef specialist. "It's also a good idea to avoid working or transporting animals



Ensure equids always have a source of fresh, clean water available during hot weather.

during periods of danger or emergency heat stress."

For dairy cattle, it is important to keep buildings as open as possible to allow air to circulate. Fans and sprinkler systems that periodically spray a cool mist on animals can make a significant difference.

Horses have difficulty regulating their body temperature when temperatures exceed 90 degrees. And if humidity

is high, even lower temperatures can make life uncomfortable for horses.

"Owners can reduce heat stress by scheduling activities during the cooler part of the day and making sure horses have plenty of water," said Bob Coleman, PhD, UK equine extension specialist. "If you do transport horses during the cooler part of the day, give water before, during, and after transportation to reduce the risk of dehydration."

Livestock Heat Stress

Coleman said even nonworking horses can double their water intake during hot weather. Owners should allow them to drink frequently to help maintain water balance.

"If you let them drink often, it can relieve the urge to drink a lot of water after exercise, and they need to gradually drink after a workout," he said. "Also, remember lactating mares have special water requirements, because they are using water for milk production as well as body temperature regulation."

Hot weather also increases horses' need for salt because they lose the mineral during sweating.

Poultry are especially prone to heat stress. Mortality during extreme heat can be significant, and egg production and hatching rates can drop.

"Since the birds don't have sweat glands to help get rid of excess body heat, they have to pant to cool down," said Jacquie Jacob, PhD, UK poultry

extension project manager. "It's important to make sure chickens are in well-ventilated areas and they have access to clean, cool water at all times."

The UK Agricultural Weather Center provides statewide and county-specific weather information, alerts, livestock heat stress conditions, and more. To

view the index for a specific location, go to weather.uky.edu/ukawc2.php or click a specific location from the Kentucky map at weather.uky.edu. **UK**

>Aimee Nielson is an agricultural communications specialist for the UK College of Agriculture, Food and Environment.

Upcoming Events

June 28, 4 – 5 p.m.

UK Department of Veterinary Science Equine Diagnostic and Research Seminar Series
Topic: A Matter of Life and Death: Equine Neutrophil Apoptosis in Inflammatory Conditions of the Intestinal Tract
Speaker: Stacy Anderson, DVM, MVSc, PhD, Dipl. ACVS, Lincoln Memorial University
Location: UKVDL, Lexington

July 26, 4 – 5 p.m.

UK Department of Veterinary Science Equine Diagnostic and Research Seminar Series
Topic: Gastric Ulcers
Speaker: Hoyt Cheramie, DVM, MS, Dipl. ACVS, Boehringer Ingelheim Animal Health
Location: UKVDL, Lexington

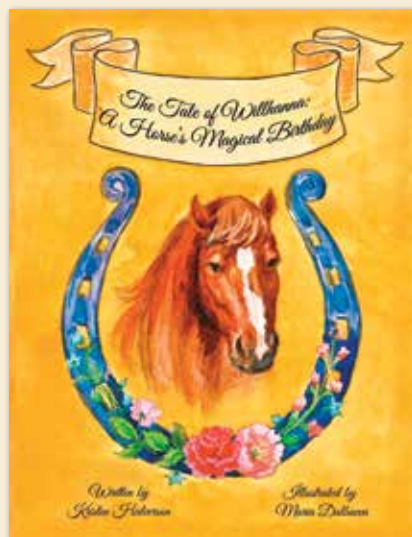
Third Book in Series Continues EPM Research Funding at Gluck

Author Kristen Halverson published the children's book *The Tale of Willhanna: A Horse's Magical Birthday* in April. This is the third book in the series in which a portion of the proceeds support the equine protozoal myeloencephalitis (EPM) research program run by Dan Howe, PhD, professor at the UK Gluck Equine Research Center.

To date, Halverson has donated \$1,285 from book proceeds. The series also includes *The Tale of Noel: The Holiday Horse Angel* and *The Tale of Josephine Rose: A Horse's Magical Neigh*.

Halverson said she continues to support

the Gluck Center because she strongly values its mission of improving horse health and well-being. She hopes to raise an additional \$2,000 from the proceeds of *The Tale of*



Willhanna: A Horse's Magical Birthday.

Halverson leverages her creative writing skills as a communication vehicle to further her EPM awareness mission, enhance EPM research funds, and honor her late Thoroughbred Nino Tempo, who was affected by EPM in 2010. She uses her Clydesdale and Morgan horses as inspiration for the stories that explore hope, kindness, and thoughtfulness.

In *The Tale of Willhanna: A Horse's Magical Birthday*, Willhanna, a wise and athletic horse is counting the days until his 10th birthday. Josephine Rose, the kind Clydesdale, and his other equine friends want to find a special way to celebrate his big day. One March afternoon, the horses seek advice from the thoughtful cow Mirabella, since she has known Willhanna for several years. Mirabella suggests holding a surprise party in the old dairy barn. As the days lead up to the

party, all the animals on the farm find additional ways to make Willhanna's birthday a memorable and magical occasion.

"The cows, horses, and cats on the farm work together as a team to plan a surprise 10th birthday celebration for Willhanna in the old dairy barn," Halverson said. "I have also centered some elements of the plot around Kentucky, as it is Willhanna's dream to see his old racing buddies from Kentucky again."

The Tale of Willhanna: A Horse's Magical Birthday is available for purchase at amazon.com/Tale-Willhanna-Horses-Magical-Birthday/dp/0692101764. Find additional information at [Twitter.com/author kristenh1](https://twitter.com/author kristenh1) and [Facebook.com/TheTaleofWillhanna](https://facebook.com/TheTaleofWillhanna). **UK**

>Jenny Evans, MFA, PhD candidate, is the senior veterinary science marketing/promotion specialist at the UK Gluck Equine Research Center.



Program

3:30 - Registration

4:00 - Exhibitor Booths

5:00 - Welcome, Dinner provided by the Mercer County Cattlemen's Association

5:30 - **Keynote Speaker: Utilizing Cost Share to Improve Grazing, Profitability and Resource Protection on Horse Farms**, *Adam Jones, NRCS State Grazing Specialist*

6:00-8:00 Educational Sessions, concurrently every half hour:

- **Weed Control Following a Wet Spring**, *Dr. Bill Witt and Keenan Bishop*
- **Implementing Rotational Grazing on Horse Farms**, *Steve Musen and Dr. Bob Coleman*
- **Rejuvenating Fall Horse Pastures**, *Dr. Ray Smith*
- **Maintaining a Healthy Horse**, *Dr. Justin Murray*

Paul and Melita Knapper run a small Thoroughbred breeding and layup operation just south of Shaker Village of Pleasant Hill. They are also the first of three established demonstration farms showcasing federal cost share opportunities on equine operations in Kentucky.

RSVP requested to equine@uky.edu or 859-257-2226



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