Name: _____ Date: _____

Four Hooves Off the Ground

Reading level 13 · 1591 words

For years, nobody could say whether a running horse ever has all four hooves off the ground at once. The argument, called "unsupported transit," divided scientists and ordinary spectators alike. In 1872 Leland Stanford, a railroad owner and racehorse enthusiast, hired the photographer Eadweard Muybridge to find out. The problem was time. Marta Braun, who has studied Muybridge for decades, notes that a typical exposure in 1872 lasted about two seconds. That is long enough for a running horse to cross a whole field. By 1877 Muybridge was using a battery of 12 to 24 cameras with an exposure of 2/1000 of a second. The Library of Congress dates his best-known sequence, of a horse named Sallie Gardner, to 19 June 1878 at Palo Alto, California. Britannica says the results proved Stanford's contention that all four feet leave the ground.

What a camera can finally show is the order in which the feet land, and that order is what defines a gait. At a walk the four feet land one at a time, in four beats, which means four separate hoof sounds. At a trot, diagonal pairs move together, right front with left hind and then left front with right hind, which makes two beats. The canter has three. One hind foot lands, then the other hind foot together with the opposite front foot, then the last front foot. After that comes a moment, called suspension, when all four feet are off the ground. The gallop looks like a faster canter but is a separate four-beat gait.

Muybridge photographed horses, but where does a horse end and a pony begin? The line turns out to be a rule rather than a fact of nature. US Equestrian's 2026 rulebook says ponies are animals that do not exceed 14.2 hands, which means fourteen hands and two inches, or 58 inches, about 147 centimeters by our arithmetic. For dressage the same rulebook switches to centimeters: 148 without shoes and 149 with shoes. For classes decided by height it also excepts some breeds, among them Arabians, Morgans and Icelandics. Registered Shetland ponies in the United States may not exceed 11.2 hands. A miniature horse can stand as short as 20 inches and is still called a horse. A polo pony can be any height, because the word names a job, not a size.

The first evidence that people kept horses comes from Botai, a culture of the Central Asian steppe. A 2018 study in Science placed the earliest archaeological evidence of horse husbandry there about 5,500 years ago. A 2021 paper in Nature describes it as evidence of bridling, milking and corralling around 3500 BC. A reader might expect those horses to be the ancestors of every horse alive today. They are not. The 2018 team sequenced 42 ancient genomes, 20 of them from Botai, and found that domestic horses from about 4,000 years ago to the present carry only about 2.7 percent Botai-related ancestry. The authors call it a

massive genomic turnover, at the same time as large movements of people in the Early Bronze Age.

The 2021 study in Nature went looking for the other lineage. By comparing 273 ancient horse genomes, its authors pinpointed the western Eurasian steppes, especially the lower Volga-Don region, as the homeland of modern domestic horses. Those horses spread fast across Eurasia from about 2000 BC, at the same time as spoke-wheeled Sintashta chariots, and replaced almost all other local populations. A 2024 follow-up in Nature used 475 genomes and dated the start of human control over the modern lineage to about 2200 BCE, when it shows close-kin mating and shorter generation times. It also found shorter generation times at Botai around 3500 BCE, which it reads as local horse husbandry before the modern bloodlines. Not everyone agrees. Science News reported that some researchers said the finding ignored earlier evidence of horsemanship.

The same DNA raised an awkward question about a famous animal. Przewalski's horse of Mongolia has long been called the last truly wild horse. The 2018 Science team reported that Przewalski's horses are the feral descendants of horses herded at Botai. That would make them escaped domestic horses, not wild ones. Smithsonian's National Zoo disagrees. Its species page argues that the Botai horses may have been tamed without ever being domesticated. Asian elephants, it notes, have worked for people for thousands of years without becoming domestic animals. The page does not mention the 2024 Nature study, which found shorter generation times in the Botai horses. By our reading, part of the argument is over what "domesticated" should mean.

Now follow a very different kind of evidence. Around 400 BCE a Greek doctor named Ctesias, who served at the Persian court, wrote the earliest description of a one-horned animal in Greek writing. In his Indica he reported wild asses in India as large as horses or larger. They had white bodies, dark red heads, bluish eyes and a horn on the forehead about a cubit, or a foot and a half, long. Cups made from the horn, he added, protected a drinker from poison. But Ctesias never visited India, and his book survives only in a summary made about 1,200 years later. Britannica says the Indica rested on reports from visitors and merchants. It thinks the animal was probably an Indian rhinoceros. A 2001 paper in a classics journal argued that the animals behind these accounts live in the highlands of Central Asia.

More than four centuries later, Pliny the Elder described a "monoceros" in book eight of his Natural History. It had the body of a horse, the head of a stag, the feet of an elephant and the tail of a boar, and a single black horn three feet long, and he added that, as people said, it could not be captured alive. Aelian, writing in the second or third century CE, repeated the claim that cups made from such horns protect against poison. The English word comes from the Latin uni and cornu, "one" and "horn." No living animal has all of Pliny's parts. By our reading, he was passing on a mix of reports. Merriam-Webster sums up the unicorn as an imaginary animal made from vague information about real ones.

Marco Polo gives a closer description. In the 1200s he wrote of "unicorns" in a land called Basma, which his translator Henry Yule took to be Sumatra. They were nearly as big as elephants, with hair like a buffalo's, feet like an elephant's, a thick black horn, a head like a wild boar's and a taste for mud. He called it "a passing ugly beast to look upon." He said it was not in the least like the stories of a unicorn caught in a maiden's lap, and "altogether different from what we fancied." Yule, writing in the 1800s, thought Polo's account was evidently written from life. He noted a puzzle. The characteristic rhinoceros of Sumatra has two horns, while Polo wrote of one, and called it a unicorn. Yule found that notable.

The horns that people could actually hold came from the Arctic. In 1577 the English explorer Martin Frobisher found a great dead fish on a small island off northern Canada. A horn two yards long grew from its snout, and he wrote that it "may truly thought to be the sea-unicorn." He gave it to Queen Elizabeth. It was the tusk of a narwhal. The Smithsonian calls it a long, spiraled tooth. It pierces the upper lip and averages about 6 to 8 feet in most males. Its nerve endings can detect temperature, pressure and particles in the water, but what it is for is still debated. For centuries traders sold such tusks as unicorn horns, and National Geographic reports that some sellers never revealed where they came from. The Met Museum says that neither a tusk nor a "unicorn horn" can protect anyone from poison.

One real animal carries the name. Elasmotherium sibiricum, the "Siberian unicorn," was a rhinoceros that weighed up to 3.5 metric tons, about 7,700 pounds by our arithmetic. It grazed on grassland from southwestern Russia and Ukraine to Kazakhstan and Siberia. It was long believed to have died out between 200,000 and 100,000 years ago. Then a team dated 23 individuals by radiocarbon. They found that it survived until at least 39,000 years ago, and perhaps until 35,000. Isotopes point to a diet specialized for dry steppe grass. The Natural History Museum's researchers found no evidence that people had anything to do with its end. By our arithmetic, Ctesias wrote more than 30,000 years after the last of them. No horn has ever been found, but a large bump of bone on the skull, called a boss, is thought to have held one.

Look back over the evidence. A footfall too quick for the eye was settled by a shutter. A history of the horse was redrawn when hundreds of ancient genomes were compared, and it was adjusted again in 2024. The unicorn story drew on a doctor's secondhand report, a rhinoceros that travelers described, and a whale's tooth that traders sold, and none of the three was a horse. In each case the object was real. By our reading, the unicorn grew in the step from one rare object to a whole story about it. The large boss on the Siberian unicorn's skull is thought to have carried a horn, but nobody has held it. Scientists still argue about how and where horses were first domesticated, and each new genome can move the answer.

Questions

1. Why could photographs from 1872 not show a running horse clearly?

A. Horses ran too slowly
B. Cameras had not been invented
C. A typical exposure took about two seconds

2. What did the 2018 DNA study find about modern domestic horses and the Botai horses?

A. They carry only a small share of Botai-related ancestry
B. They all descend from Botai horses
C. They have no ancient ancestors

3. Why does the book say part of the Przewalski's horse argument is over a definition?

A. Both sides agree on every gene
B. The two sides use the word domesticated differently
C. Nobody has ever seen the horse

4. In 'the Indica rested on reports from visitors and merchants', what does rested on mean?

A. was based on
B. was tired of
C. was hidden under

5. Why does Yule's note about the horns matter?

A. It proves unicorns lived in Sumatra
B. It shows Polo never left Europe
C. Polo's animal was real, but it did not match the story exactly

6. What is still unknown about the Siberian unicorn?

A. Whether it was a rhinoceros
B. Whether it really had a horn, since none has been found
C. When Ctesias saw it

Words to know

gait: way of moving
genomes: full DNA sets
feral: gone wild
domesticated: bred for people
radiocarbon: carbon dating
tusk: long tooth

Answer key: Four Hooves Off the Ground

1. C. A typical exposure took about two seconds
2. A. They carry only a small share of Botai-related ancestry
3. B. The two sides use the word domesticated differently
4. A. was based on
5. C. Polo's animal was real, but it did not match the story exactly
6. B. Whether it really had a horn, since none has been found