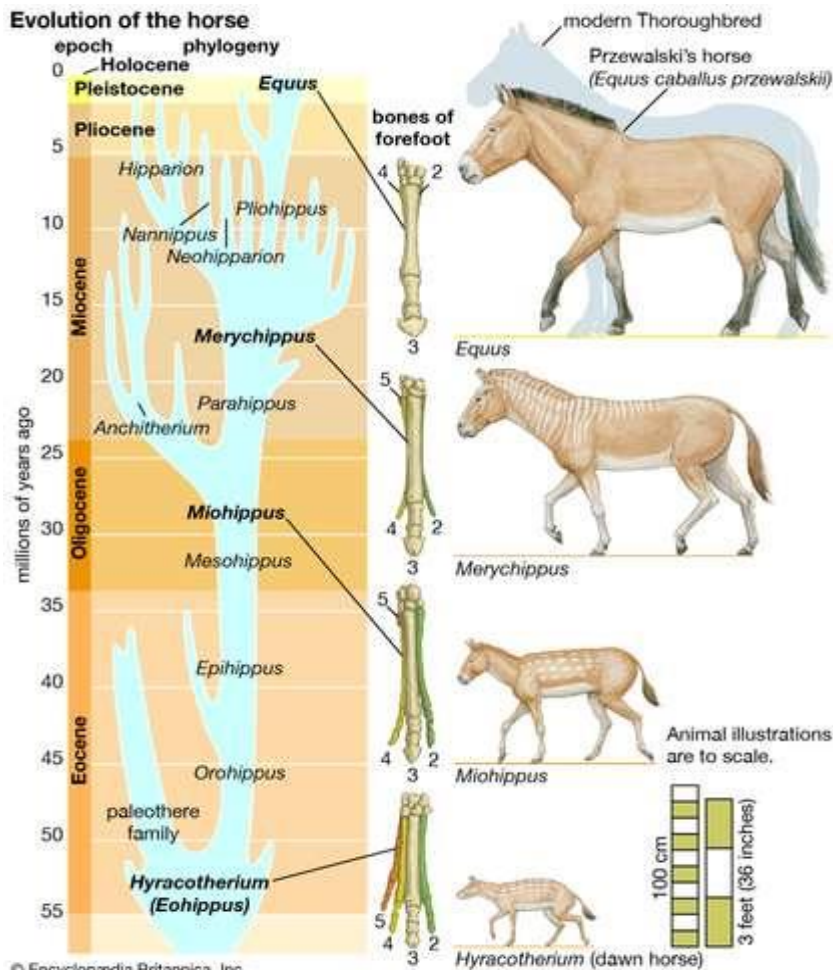
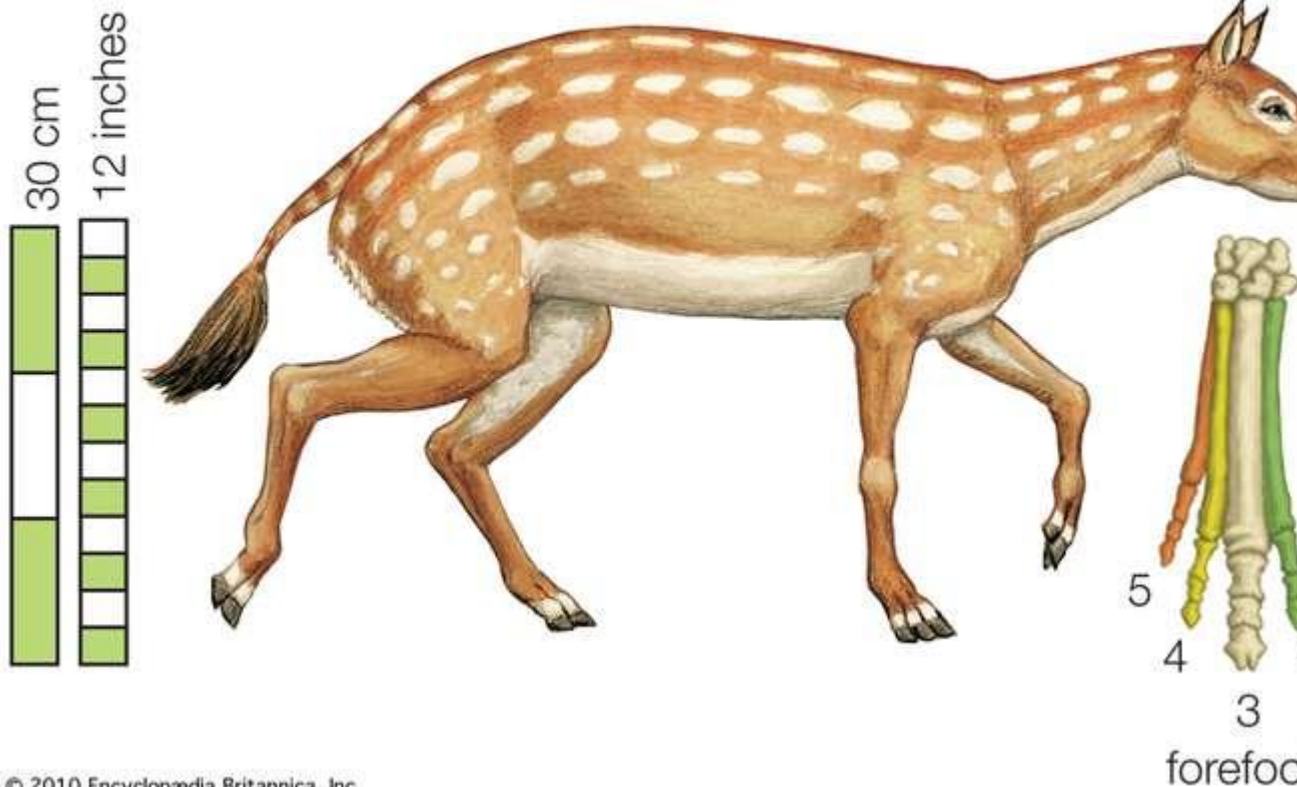


# EVOLUTION OF THE HORSE

The evolutionary lineage of the horse is among the best-documented in all paleontology. The history of the horse family, Equidae, began during the Eocene Epoch, which lasted from about 56 million to 33.9 million years ago. During the early Eocene there appeared the first ancestral horse, a hoofed, browsing mammal designated correctly as *Hyracotherium* but more commonly called *Eohippus*, the “dawn horse.” Fossils of *Eohippus*, which have been found in both North America and Europe, show an animal that stood 4.2 to 5 hands (about 42.7 to 50.8 cm, or 16.8 to 20 inches) high, diminutive by comparison with the modern horse, and had an arched back and raised hindquarters. The legs ended in padded feet with four functional hooves on each of the forefeet and three on each of the hind feet—quite unlike the unpadded, single-hoofed foot of modern equines. The skull lacked the large, flexible muzzle of the modern horse, and the size and shape of the cranium indicate that the brain was far smaller and less complex than that of today’s horse. The teeth, too, differed significantly from those of the modern equines, being adapted to a fairly general browser’s diet. *Eohippus* was, in fact, so unhorse like that its evolutionary relationship to the modern equines was at first unsuspected. It was not until paleontologists had unearthed fossils of later extinct horses that the link to *Eohippus* became clear.



## dawn horse (*Hyracotherium*)



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**evolution of the horse** Evolution of the horse over the past 55 million years. The present-day Przewalski's horse is believed to be the only remaining example of a wild horse—i.e., the last remaining modern horse to have evolved by natural selection. Numbered bones in the forefoot illustrations trace the gradual transition from a four-toed to a one-toed animal.

***Eohippus*** *Eohippus*, Existing toe bones of the forefoot are numbered outward from the centre of the body. Officially, taxonomists have classified this extinct mammal, which is considered to be the first known horse, in the genus *Hyracotherium*.

The line leading from *Eohippus* to the modern horse exhibits the following evolutionary trends: increase in size, reduction in the number of hooves, loss of the footpads, lengthening of the legs, fusion of the independent bones of the lower legs, elongation of the muzzle, increase in the size and complexity of the brain, and development of crested, high-crowned teeth suited to grazing. This is not to imply that there was a steady, gradual progression in these characteristics leading inevitably from those of *Eohippus* to those of the modern horse. Some of these features, such as grazing dentition, appear abruptly in the fossil record, rather than as the culmination of numerous gradual changes. *Eohippus*, moreover, gave rise to many now-extinct branches of the horse family, some of which differed substantially from the line leading to the modern equines.



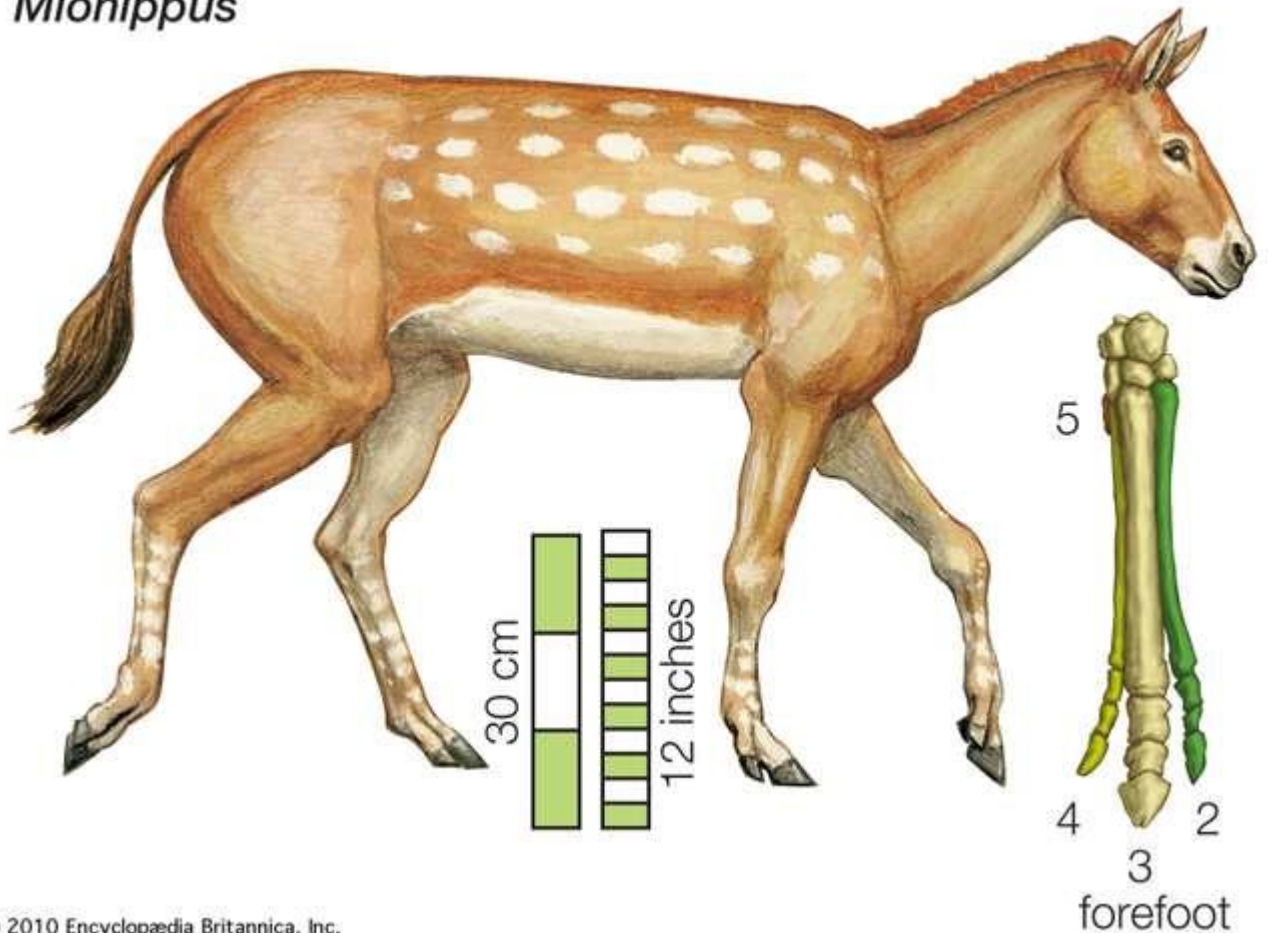
***Hyracotherium, or Eohippus***A specimen of *Hyracotherium*

Although *Eohippus* fossils occur in both the Old and the New World, the subsequent evolution of the horse took place chiefly in North America. During the remainder of the Eocene, the prime evolutionary changes were in dentition. *Orohippus*, a genus from the middle Eocene, and *Epihippus*, a genus from the late Eocene, resembled *Eohippus* in size and in the structure of the limbs. But the form of the cheek teeth—the four premolars and the three molars found in each half of both jaws—had changed somewhat. In *Eohippus* the premolars and molars were clearly distinct, the molars being larger. In *Orohippus* the fourth premolar had become similar to the molars, and in *Epihippus* both the third and fourth premolars had become molar like. In addition, the individual cusps that characterized the cheek teeth of *Eohippus* had given way in *Epihippus* to a system of continuous crests or ridges running the length of the molars and molariform premolars. These changes, which represented adaptations to a more-specialized browsing diet, were retained by all subsequent ancestors of the modern horse.

Fossils of *Mesohippus*, the next important ancestor of the modern horse, are found in the early and middle Oligocene of North America (the Oligocene Epoch lasted from about 33.9 million to 23 million years ago). *Mesohippus* was far more horselike than its Eocene ancestors: it was larger (averaging about 6 hands [about 61 cm, or 24 inches] high); the snout was more muzzle like; and the legs were longer and more slender. *Mesohippus* also had a larger brain. The fourth toe on the forefoot had been reduced to a vestige, so that both the forefeet and hind feet carried three functional toes and a footpad. The teeth remained adapted to browsing.

By the late Oligocene, *Meshippus* had evolved into a somewhat larger form known as *Miohippus*. The descendants of *Miohippus* split into various evolutionary branches during the early Miocene (the Miocene Epoch lasted from about 23 million to 5.3 million years ago). One of these branches, known as the anchitheres, included a variety of three-toed browsing horses comprising several genera. Anchitheres were successful, and some genera spread from North America across the Bering land bridge into Eurasia.

## *Miohippus*



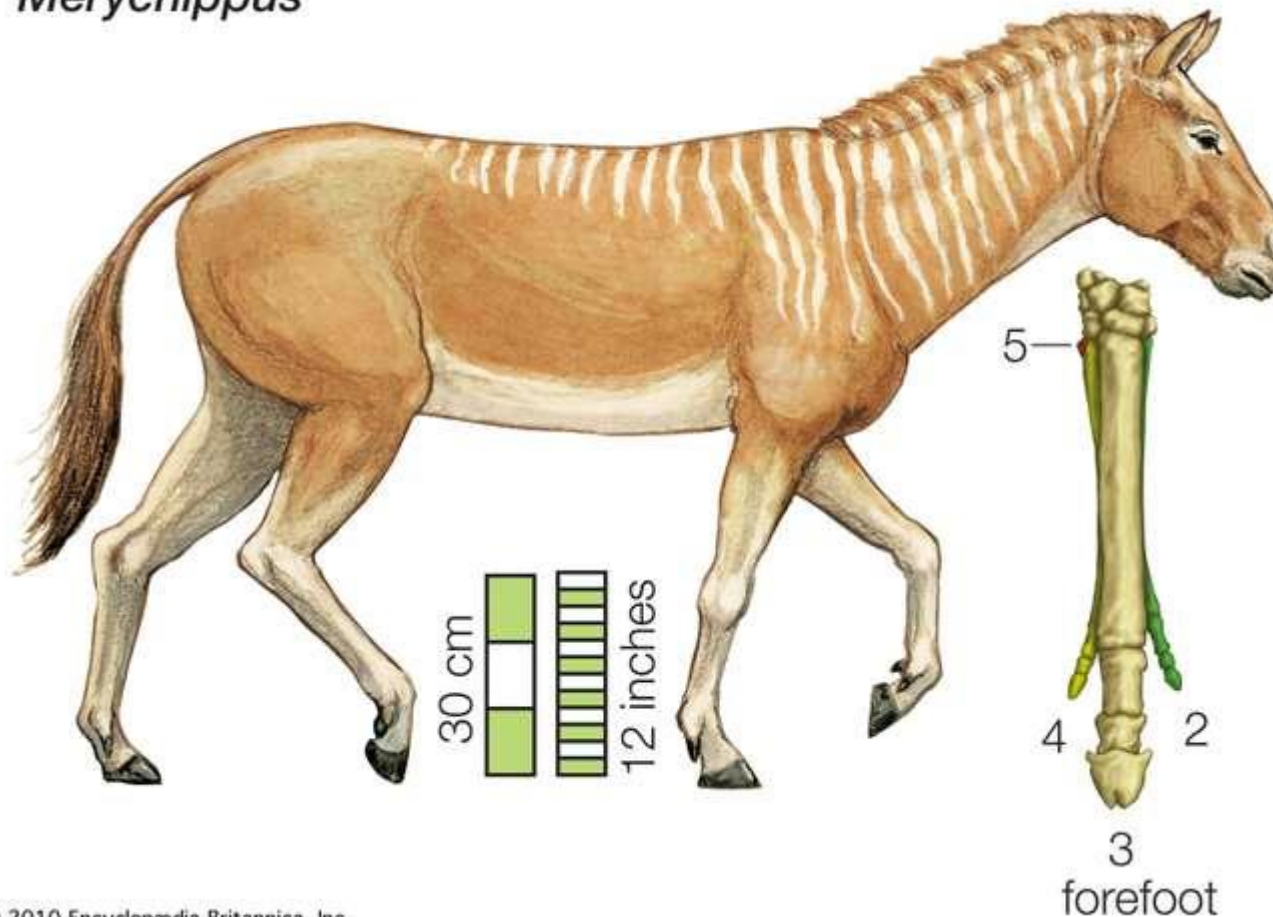
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The ancestral horse *Miohippus*, Existing toe bones of the forefoot are numbered outward from the centre of the body.

It was a different branch, however, that led from *Miohippus* to the modern horse. The first representative of this line, *Parahippus*, appeared in the early Miocene. *Parahippus* and its descendants marked a radical departure in that they had teeth adapted to eating grass. Grasses were at this time becoming widespread across the North American plains, providing *Parahippus* with a vast food supply. Grass is a much coarser food than succulent leaves and requires a different kind of tooth structure. The cheek teeth developed larger, stronger crests and became adapted to the side-to-side motion of the lower jaw necessary to grind grass blades. Each tooth also had an extremely long crown, most of which, in the young animal, was buried beneath the gumline. As grinding wore down the exposed surface, some of the buried crown grew out. This high-crowned tooth structure assured the animal of having an adequate grinding surface throughout its normal life span. Adaptations in the digestive tract must have occurred as well, but the organs of digestion are not preserved in the fossil record.

The change from browsing to grazing dentition was essentially completed in *Merychippus*, which evolved from *Parahippus* during the middle and late Miocene. *Merychippus* must have looked much like a modern pony. It was fairly large, standing about 10 hands (101.6 cm, or 40 inches) high, and its skull was similar to that of the modern horse. The long bones of the lower leg had become fused; this structure, which has been preserved in all modern equines, is an adaptation for swift running. The feet remained three-toed, but in many species the footpad was lost, and the two side toes became rather small. In these forms, the large central toe bore the animal's weight. Strong ligaments attached this hoofed central toe to the bones of the ankles and lower leg, providing a spring mechanism that pushed the flexed hoof forward after the impact of hitting the ground. *Merychippus* gave rise to numerous evolutionary lines during the late Miocene. Most of these, including *Hipparion*, *Neohipparion*, and *Nannippus*, retained the three-toed foot of their ancestors. One line, however, led to the one-toed *Pliohippus*, the direct predecessor of *Equus*. *Pliohippus* fossils occur in the early to middle Pliocene beds of North America (the Pliocene Epoch lasted from about 5.3 million to 2.6 million years ago).

## *Merychippus*





The ancestral horse *Merychippus*. Existing toe bones of the forefoot are numbered outward from the centre of the body.

**fossil molar of *Merychippus*** The grooves on the fossil molars of *Merychippus* suggest that the species used its teeth to grind up grasses rather than leaves and fruits.

*Equus*—the genus to which all modern equines, including horses, asses, and zebras, belong—evolved from *Pliohippus* some 4 million to 4.5 million years ago during the Pliocene. *Equus* shows even greater development of the spring mechanism in the foot and exhibits straighter and longer cheek teeth. This new form was extremely successful and had spread from the plains of North America to South America and to all parts of the Old World by the early Pleistocene (the Pleistocene Epoch lasted from about 2,600,000 to 11,700 years ago). *Equus* flourished in its North American homeland throughout the Pleistocene but then, about 10,000 to 8,000 years ago, disappeared from North and South America. Scholars have offered various explanations for this disappearance, including the emergence of devastating diseases or the arrival of human populations (which presumably hunted the horse for food). Despite these speculations, the reasons for the demise of *Equus* in the New World remain uncertain. The submergence of the Bering land bridge prevented any return migration of horses from Asia, and *Equus* was not reintroduced into its native continent until the Spanish explorers brought horses in the early 16th century.

During the Pleistocene the evolution of *Equus* in the Old World gave rise to all the modern members of the genus. The modern horse, *Equus caballus*, became widespread from central Asia to most of Europe. Local types of horses, all breeds of this single species, undoubtedly developed, and three of

these—Przewalski's horse (*E. ferus przewalskii* or *E. caballus przewalskii*) from central Asia, the tarpan from eastern Europe and the Ukrainian steppes, and the forest horse of northern Europe—are generally credited as being the ancestral stock of the domestic horse. (Przewalski's horse may be the last surviving distinct breed of wild horse when compared genetically with domesticated horses.) According to this line of thinking, Przewalski's horse and the tarpan formed the basic breeding stock from which the southerly "warm-blooded" horses developed, while the forest horse gave rise to the heavy, "cold-blooded" breeds.