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Hoofprints through history

From his origins as a dog-sized forest-dweller, the modern horse has come a long way. We explore the evolutionary journey and how it affects our equine friends in domesticated life

OUR EXPERT

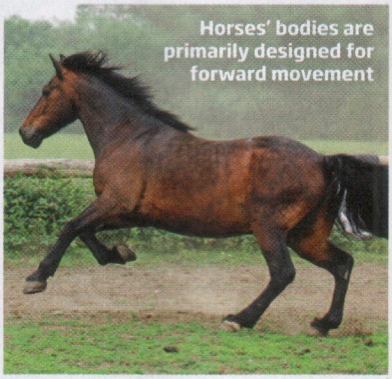
SUE PALMER is a chartered veterinary physiotherapist and equine behaviour consultant. Her instructional 'Horse Massage for Horse Owners' is available as a book, DVD or course. For more information, visit www.holistichorsehelp.com

The horse is one of the few animals with a fairly complete evolutionary record, and it has an enormous family tree, packed with different and often overlapping species. Of all those variants, only the Equus genus, which includes our modern horses, zebras and asses, now remains, but the milestone stages of evolution have been preserved in fossil form and show how, over millions of years, the horse has evolved into the animal we know and love today.

Horses are incredibly adaptable animals, demonstrated both by their evolution and the way they cope with the work we ask of them, from racing to dressage to jumping and more. This adaptability is the key to the success of the horse-human relationship, and by understanding how evolution has shaped our horses we can also gain a much deeper appreciation of just how domestication, and all it entails, affects them.

Designed for forward motion

The physical structure of the modern horse supports his main survival tactic – out-running predators in a straight line through the flight response. "His joints, like the knees and the hocks, are designed for going forwards and backwards, not out to the side," explains our expert



Horses' bodies are primarily designed for forward movement

1 Hyracotherium

Lived: From 55 million years ago
Height: Around 40cm
Also known as Eohippus, or 'dawn horse', the Hyracotherium is thought to have lived in tropical rainforests, where it ate soft, succulent leaves from plants, shrubs and trees with its short-crowned teeth. It had four toes on its forefeet and three on its hind, all with thick, horny nails and supported by a pad behind to spread its weight over the soft and marshy ground. Its eyes were set centrally in its head and it had a rounded back.

2 Mesohippus

Lived: From 37 million years ago
Height: From 45cm
Mesohippus was the next significant development, with longer legs and three-toed forefeet, of which the central toe was becoming more prominent. There were also the start of pre-molar or incisor teeth for coping with a wider variety of foliage. These adaptations can be linked to a drier climate, the firmer ground of wooded scrublands replacing the soft-floored rainforests. Around 30 million years ago, the slightly more advanced Miohippus evolved, measuring 60cm-plus, with more obvious incisors.

3 Merychippus

Lived: From 17 million years ago
Height: 1 metre
The much larger and taller Merychippus was an evolutionary milestone. It looked more like a modern horse and, although each foot still had three toes, its weight was increasingly taken on the central ones. The Merychippus had stronger, higher-crowned teeth to cope with the development of tough grasses in the new plains, making it the first known grazing horse. Other adaptations included a longer neck for eating from the floor plus a head shape and eye placement which gave better vision.

Sue Palmer. "His forelegs are attached to the body with muscle only, but his hindlegs are attached via bone through his pelvis and spine, which is what enables the power of his quarters to translate into speed."

The horse is unique in his combination of power, speed and endurance, says Sue. "His power comes from his huge muscles, particularly in his hind limbs. The legs act like springs, or pogo sticks, storing energy in long tendons, which means that less energy is required from his muscles for movement, especially in the faster paces, which enables him to move at speed."

His body also helps boost his speed, with ligaments in the back and stomach which work together to reduce the muscular energy required, particularly for galloping. The muscles themselves contain different types of fibres linked to either endurance or speed, and different breeds of horse will have different ratios of each type, making them better suited to different kinds of work.

Helping equine endurance are the horse's huge lungs, which enable him to get lots of oxygen into his system, helped by the ability to release extra red blood cells into the circulatory system when required. Sue explains: "Red blood cells are essential for transporting oxygen around the body, and the horse stores extra cells in his spleen which can be released during intense exercise."

Carrying riders

The way horses have evolved to move is quite different to some of the ways we ask them to work. Their adaptability means they can meet our requests, but there are some associated risks and problems. "Horses have evolved to move mostly at slow speeds over large distances each day as they graze, with occasional bursts of speed, such as when a predator is spotted," says Sue. "We work them very differently, which puts strain on their musculoskeletal system. Another obvious problem is that the horse didn't evolve to be ridden, and so has to develop muscle tone to help support a rider

Even hacking requires muscle tone to support carrying a rider

HOOF HANGOVER

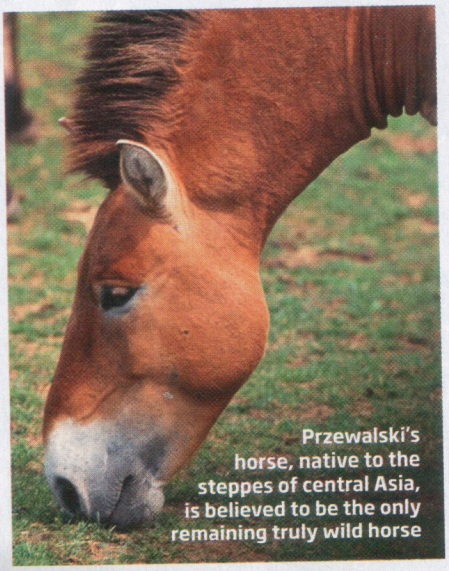
The foot pads of the Hyracotherium have become the ergots found behind modern horses' fetlocks

4 Pliohippus

Lived: From 12 million years ago
Height: 1.2 metres
Pliohippus was the first single-hoofed 'horse' and was the direct ancestor of the modern horse. It had fully-developed grazing teeth, the general proportions of the modern horse, and was also the source for the group containing zebras, domestic and wild asses, and the hemionids or 'half-asses'. The 'true' horse (Equus caballus) developed from Pliohippus, and spread from North America around 10,000 years ago over the land bridges which joined it to the mainland of Europe and Asia.

5 Equus (Modern)

Lived: From 5 million years ago
Height: 1.6 metres
The modern horse, or Equus, is the only survivor of the once diverse family of horses, and its fossils are found on every continent except Australia and Antarctica. Around 3,000 years ago the process of domestication began, with a huge impact on human history. With domestication eventually came selective breeding, which accelerated equine evolution into the breeds and types we see and ride today.

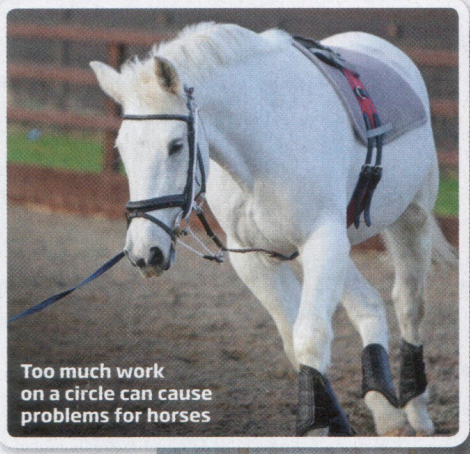


Przewalski's horse, native to the steppes of central Asia, is believed to be the only remaining truly wild horse

on his back, which applies as much to happy hackers as to competition horses, which people often seem to forget."

As well as carrying us, horses have to cope with the different directions we ask them to move in, which can cause problems, especially if they fall outside the forward-back plane of movement.

"As anyone with carpal tunnel syndrome or tennis elbow knows, repetitive strain can be very painful, and horses can suffer a similar problem doing things like too many circles, or the same type of exercise too many times, such as working towards collection," says Sue.



Too much work on a circle can cause problems for horses

Feeding from hay nets interrupts the alignment of the horse's teeth

Concussion from things like jumping too often or fast work on hard ground can damage the musculoskeletal system, and continually working on the same surface can also cause problems. "Riding only on the road or only in an arena won't put the horse's body through the range of stresses it needs to function at its maximum. This can lead to damage in the long term, so working on a variety of surfaces is really important," explains Sue.

Modern management vs evolution

The way we keep our horses can also place stress on their bodies and minds, from the type of feed we give them to the fact they no longer live in herds.

Sue says: "Horses evolved to graze from the ground, so things like using hay nets can cause problems, partly because their teeth are aligned for eating from the ground, and partly because the angle the horse holds his head at to pull hay from the net or rack creates pressure at the poll, leading to pain and tightness."

Stabling also interrupts natural patterns of behaviour. "Horses are designed to graze for most of the day and night, and it's been shown that leaving a horse for longer than four hours without food can lead to stomach ulcers, and yet many horses have finished their evening hay by 10pm," points out Sue. "Also, we all stiffen up if we spend too long standing still, so stabling horses for many hours a day is likely to cause stiffness."

CALM A SPOOKER

Turning in a small circle helps a spooking horse feel he's still running and calms him safely

Horses have evolved to live in herds, not on their own

Brain evolution

As well as shaping his body, evolution also shaped the horse's mind, as equine behaviourist Dr Debbie Marsden explains

"All equine behaviour is the result of evolution. A horse's main survival tactic – to run quickly from danger and think later – developed because of their predators. This same response accounts for spooky behaviour – things like a leaf falling, little bits of light on the ground or movement in grass could all signal a predator about to break cover.

"Social behaviour was also shaped by evolution. As the grassy plains developed so did the survival benefits to living in a big herd. Establishing relationships also facilitates escape in an emergency. Establishing who's boss and playing together enables horses to create relationships so they know each other's reactions and don't get in each other's way when they run from danger.

"This hierarchy also means that when food or water is scarce they don't waste time fighting over it – the more dominant horses take precedence and are the ones that survive to pass on their DNA."

• Find out more about your horse's behaviour at www.societyofequinebehaviourconsultants.org.uk