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# THE HORSE

presented by AMERICAN MUSEUM OF NATURAL HISTORY 

June 1, 2012–January 20, 2013

**EDUCATOR'S GUIDE**  
[www.sdnhm.org/the-horse](http://www.sdnhm.org/the-horse)



# essential QUESTIONS

This exhibition explores biological and cultural aspects of the horse, a species closely associated with humankind for millennia. You can use the Essential Questions below to connect *The Horse's* educational themes to your curriculum.

## What can we learn about evolution by studying the horse?

- **Evolution of species:** The abundance of horse fossils makes this a well-studied group of animals, and one that serves as a solid example of **evolution**. The horse family, known as Equidae, first emerged in North America 55 million years ago and has changed over time. The general trend went from smaller to larger species. Yet this evolution did not proceed in a steady, linear sequence. Rather, new species diverged from common ancestors like branches on a tree. Nearly all of these diverse horses went **extinct**. Today the family Equidae, which also includes asses and zebras, has only seven **species**.
- **Natural selection:** About 35 million years ago, climate change began turning North America's wet forests into dry grasslands. This affected horse evolution. Today's horses show many **adaptations** to the plains habitat. For example, early horses had three or four toes, each ending in a small hoof. But those with bigger, stronger middle toes were better adapted to run on dry, hard ground. **Natural selection** eventually led to the near-disappearance of the side toes, while the remaining middle toe, with its hoof, became much larger.



- **Artificial selection:** Humans breed horses by mating individuals that possess desirable natural **traits**, such as strength and size for workhorses and slender, speedy legs for racehorses. This **artificial selection** has resulted in more than 200 varied **breeds** of horses. Yet all belong to one species—*Equus caballus*.

All horses living today belong to one species.

## What are key structures, functions, and behaviors of the horse?

Horses are natural candidates for **domestication**. They have many traits that enable them to be employed all day long. For example, horses can digest food continuously without needing to rest. The anatomy of their “locking knee” enables them to conserve energy while standing more than 20 consecutive hours. Furthermore, horses are social and are naturally submissive to a leader. Such behaviors allow humans to easily control horses.

## How do scientists gather data and interpret evidence?

Paleontologists and archaeologists have many questions about horse evolution and history. What were the habitats of early horses like? Where and when were horses first domesticated? Scientists must identify, collect, and analyze evidence such as bones, artifacts, and DNA to develop hypotheses and theories.

## How have humans used horses to transform civilizations around the world and over time?

Horses have played a critical role in the development of societies. For much of human history, the use of the horse bestowed power and drove technological advances. While the role of horses has diminished today, they remain important to many people.

- **Warfare:** From Iron Age cavalry to Japanese samurai, from Spanish conquistadors to the modern era, warriors on horseback had distinct combat advantages.
- **Work:** For millennia, people have used horses to haul goods, herd cattle, plow fields, mine coal, and more.
- **Status and Spirituality:** Horses are a symbol of wealth and prestige in many societies. To this day, some cultures incorporate horses into their sacred rituals.
- **Travel and Trade:** Horses provided critical mobility and contact between civilizations before motor vehicles. For example, they enabled the vast Mongol empire to achieve its size and America's Pony Express its speed.
- **Sports:** Humans have developed elaborate sports around horses' athletic abilities, including polo, hunting, and numerous forms of racing.



Horses are fast, but they overheat if they run at top speed for too long. So, like other postal relays, the Pony Express used a series of horses to shuttle mail across long distances.



## Useful Terms & Concepts

### adaptation

A heritable change that improves the ability of an individual or species to survive in an environment.

### artificial selection

The breeding of animals by humans to pass on desired traits to the next generation. Darwin originated the term to contrast with natural selection.

### breed

A group of individuals within a species that exhibit particular traits as a result of artificial selection. For example, Arabians and thoroughbreds are two breeds of the horse species.

### domestication

The taming and breeding of animals.

### evolution

The scientific theory explaining how groups of living things change over time.

### extinction

The state in which living representatives of a species no longer exist.

### species

A particular kind of organism. Individuals of the same species can mate to produce viable fertile offspring.

### trait

Any characteristic that is observable and measurable. Traits can be expressed genetically, environmentally, or as a combination of the two.

### wild

A non-domesticated animal.

## How Does Natural Selection Work?

Natural selection is the process by which species evolve over time. Individuals inherit traits, or features, from their parents. No two organisms (except identical twins) are exactly alike genetically. This is called individual variation. Inherited variation comes from the mixture of genetic information from parents, and very occasionally from new mutations (copying errors of DNA).

Those individuals with traits that allow them to survive better will tend to pass those characteristics to their offspring. Such traits may eventually become common in the population. Over time, populations may become so different from each other that they can no longer breed together—becoming separate species.

**What is a Theory?** Find out at:  
[amnh.org/resources/rfl/web/horseguide/](http://amnh.org/resources/rfl/web/horseguide/)

## Come Prepared

Before your visit, consider what you'd like your students to learn from *The Horse*. Review the **Essential Questions** at left to see how the exhibition's educational themes can connect to your curriculum. Make a plan for how your class will investigate the exhibition and continue learning back in the classroom.

There are many ways to explore *The Horse* exhibition:

- You (and your class chaperones) can move through the gallery with students using the **Teaching in the Exhibition** section of this guide.
- You may wish to create student worksheets using the **guiding questions** from Teaching in the Exhibition.
- You may wish to distribute copies of the **Map of the Exhibition** beforehand to chaperones and/or students.

Visit [www.sdnhm.org/the-horse](http://www.sdnhm.org/the-horse) for:

- information on field trips, reservations, and other useful tips to help plan your visit
- free online resources, including activities and reference lists related to the exhibition

## Correlation to Standards

*The Horse* is correlated to the California State Content Standards. Full texts of standards available at <http://www.cde.ca.gov/index.asp>

### Science

**All grades** • Abilities necessary to do scientific investigation and experimentation.

**Grade K** • Life Sciences 2

**Grade 1–2** • Life Sciences 2a–d, Earth Science 3d

**Grade 3** • Life Sciences 3a–e

**Grade 4–5** • Life Sciences 2, 3b, c

**Grade 6** • Ecology

**Grade 7** • Genetics, Evolution, Earth and Life History, Structure and Function in Living Systems

**Grade 9–12** • Biology/Life Sciences, Ecology, Evolution

### History–Social Science

**Kindergarten** • Learning and Working Now and Long Ago 1, 6.3

**Grade 1** • A Child's Place in Time and Space 4.2

**Grade 4** • California: A Changing State 4.1

**Grade 5** • U.S. History and Geography: Making a New Nation 8.1

**Grade 6** • World History and Geography: Ancient Civilizations 1.1, 1.3

# TEACHING in the exhibition

*The Horse* exhibition engages all learning styles through hands-on and digital interactives, specimens, videos, and more. You'll find the six areas below on the **Map of the Exhibition**. Each area includes an overview, exploration ideas, and guiding questions.

## 1. The Evolution of Horses

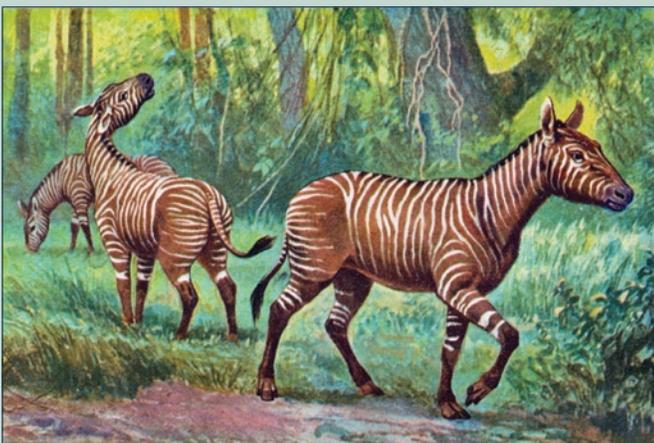
**Overview:** This area describes the evolution of the horse. It depicts the great diversity of the family Equidae, the major stages of its evolution, and key biological adaptations.

### Exploration:

- **Diorama and touchable fossils and casts:** Invite students to compare and contrast the physical traits of the ancient horse species depicted here.
- **“Scientist at Work” video:** Students can watch how paleontologist Bruce MacFadden examines fossil horse teeth to distinguish grass-grazers from leaf-browsers, revealing clues about ancient environments.
- **“Meet the Relatives” wall panel:** Students can examine the seven living species of the family Equidae—and their close relatives, tapirs and rhinos.

### Guiding Questions:

- How did ancient horses differ from horses today?
- How did the variety of horse species change over time?
- What traits helped ancient horses survive in their environments?
- How did modern horses become adapted to a dry, grassy habitat?



Three-toed, leaf-eating horses such as *Hypohippus* persisted in the forests of North America until about 9 million years ago.

## 2. Horses and Hunters

**Overview:** This area includes cave paintings, tools, and other prehistoric evidence showing that humans' first relationship with horses was hunting them for meat.

### Exploration:

- **Cave art, tools, and horse bones:** Ask students to observe and describe what the three paintings depict and what the tools were used for.

### Guiding Question:

- What do the cave art, tools, and bones suggest about the lives of Ice Age people and their relationship to horses?

## 3. Domesticating Horses

**Overview:** This area recreates Krasnyi Yar, the site of a 5,000-year-old human settlement in Kazakhstan where archaeologists are investigating the question: Were horses domesticated here?



At Krasnyi Yar, the site of an ancient village, scientists found these horse bones carefully buried—a clue to domestication.

### Exploration:

- **Dig site diorama and village model:** Invite students to investigate this display and gather as much evidence for horse domestication as they can.
- **“Scientist at Work” video:** Students can learn why it is challenging for archaeologists like Sandra Olsen to definitively answer where and when horses were first domesticated.

### Guiding Questions:

- What questions are scientists investigating at Krasnyi Yar?
- How are scientists using technology in their search for evidence?
- What evidence have they found?
- How have scientists used the evidence to develop an explanation?

## Horse Breeds

There are more than 200 breeds of horses today, which vary in shape, size, color, and other traits. Explore these breeds and more in the Horse Breeds interactive in Area 6 of the exhibition.



Appaloosa

Arabian

Belgian Draft

Friesian

## 4. The Nature of Horses

**Overview:** This area highlights the biological traits that make horses well suited for domestication.

### Exploration:

- **Biology of the Horse interactives:** Students can explore the form and function of the ears, eyes, digestive system, and locomotion of the horse on a life-size video screen using two interactive stations.
- **The Nature of Horses railing panels:** Students can learn which behavioral traits of the horse make it ideal for domestication.

### Guiding Question:

- What physical and behavioral traits make horses useful to humans?

## 5. How We Shaped Horses How Horses Shaped Us

**Overview:** This area depicts how people's use of the horse has transformed societies around the world and across time. It covers the realms of warfare, work, status and spirituality, travel and trade, and sports.

### Exploration:

- **Warfare:** Students can examine artifacts that depict warriors on horseback around the world as well as horse tack and armor.
- **Horsepower interactive:** Students can push the bar to measure their horsepower.
- **Draft horse/Shetland pony skeletons:** Invite students to compare the form and function of two very different breeds of workhorses.



People bred small Shetland ponies to work in coal mine shafts.

- **“Spin and Look In” zoetrope:** Students can compare horse gaits with this device featuring the famed historical stop-action photography of Eadward Muybridge.
- **Horse regalia:** Students can observe the ways different cultures dress and use horses as status symbols.



This 100-year-old saddle was likely used by a wealthy rider in Russia's Sakha Republic.

- **Locking Leg model:** Students can move the bones and ligaments in a model leg to understand why horses can stand all day without tiring.
- **Sports:** Students can explore how different cultures use horses for sport.

### Guiding Questions:

- In what ways have humans used horses?
- How has their use transformed human societies?
- What are some examples of the use of horses as symbols of wealth and status?

## 6. An Enduring Bond

**Overview:** The role of the horse has dwindled in most societies today, but our relationship with them continues. This area features ongoing and emerging roles for horses, such as their use in therapy.

### Exploration:

- **Horse Breeds interactive:** Students can explore 18 breeds of horses and learn how their traits differ.

### Guiding Questions:

- What traits do horse breeders select? Why?
- What are examples of the bond between horses and humans?
- How are the roles of horses changing over time?



# back in the CLASSROOM

## Activities

**Horse Object (K–8):** Ask students to find an advertisement, an image, or an object that depicts a horse from any culture—historical or contemporary. Have students describe what the horse is doing and its surroundings. Ask: What do your observations tell you about how this culture views the horse?

**Compare Hoof & Tooth Fossils (K–5):** Visit [amnh.org/resources/exhibitions/horse/edresources.php](http://amnh.org/resources/exhibitions/horse/edresources.php) for an activity where students can compare and contrast the hooves and teeth of extinct and living horse species. They can use their observations to explore how horses are adapted to particular habitats.

**Field Trip (K–12):** Offer students a connection to live horses or zebras by visiting a farm, a stable at a racetrack, a riding center, or a zoo. Have students sketch one of the animals, observing and noting physical and behavioral traits.

**Story: One-Horse Town? (3–8):** Have students research historical images of their town 100 years ago and note how horses were integral to daily life. (Try your local library or historical society, or online image resources such as the Library of Congress’s “American Memory”: [memory.loc.gov/ammem/](http://memory.loc.gov/ammem/)) They can also search for modern-day clues to past horse presence, such as buildings that were once carriage houses. Students can then compose a fictional “day-in-the-life” story from the point of view of a person living a century ago, highlighting how horses were used.

**Calculate Horsepower (5–8):** Download the worksheet at [amnh.org/resources/exhibitions/horse/edresources.php](http://amnh.org/resources/exhibitions/horse/edresources.php) for a math activity on the unit of “horsepower.”

**Horse Racing Debate (5–12):** While horse racing is a thrilling sport with a storied past, it has its issues. For example, thoroughbred horses are bred for speed, not strength. Under the strain of racing, their leg bones may break with a misstep. And some retired racehorses that cannot find new homes are euthanized. Have students research the pros and cons of horse racing. Then hold a class debate over whether and how it should continue.

## Discuss the Exhibition

**Build on what your students learned at the Museum with these conversation starters:**

- What did you learn about horses that surprised you?
- How do scientists learn about the evolutionary history of horses?
- How do scientists learn about the history of horse domestication?
- What physical and behavioral traits make the horse so useful to humans?
- How has the relationship between horses and humans changed over time?

## Online Resources

- **The Horse for Educators**  
[amnh.org/education/horse](http://amnh.org/education/horse)  
You’ll find free online resources, including activities and reference lists.
- **Ology: The Horse**  
[amnh.org/ology/horse](http://amnh.org/ology/horse)  
Students can explore an interactive on horse breeds, make flipbooks to study horse gaits, and more.
- **Science Bulletins: Takhi—The Last Wild Horse**  
<http://www.amnh.org/sciencebulletins/?sid=b.f.takhi.20080501>  
Students can watch a documentary video on the reintroduction of takhi, the only surviving wild horse, to Mongolia. Essays, interactives, and educator resources accompany the video.
- **Ology: Tree of Life**  
[amnh.org/ology/treeoflife](http://amnh.org/ology/treeoflife)  
Students can explore the Tree of Life cladogram and learn how scientists sort species based on shared characteristics. While horses are not listed on the diagram, students can find mammals, one of the taxonomic groups to which horses belong.

## CREDITS

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See page 7 for a list of supporters for the **San Diego** exhibition.

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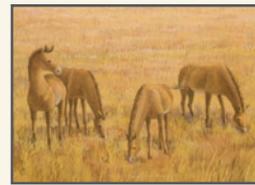
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# MAP of the exhibition



## 1. The Evolution of Horses



Explore the evolution, diversity, and adaptations of the family Equidae.

## 2. Horses and Hunters



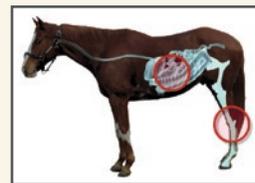
You'll find cave paintings, tools, and other evidence of humans' first relationship with horses.

## 3. Domesticating Horses



Were the horses at Krasnyi Yar domesticated? This area recreates an archaeological site at a 5,000-year-old settlement.

## 4. The Nature of Horses



Investigate the biological traits that make horses a natural for domestication.

## 5. How We Shaped Horses How Horses Shaped Us



Examine the horse's transformative role in cultures around the world and across time.

## 6. An Enduring Bond



Explore the relationship that endures between horses and humans in ongoing and emerging realms.

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**WWW Foundation**

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