Horse Evolution
- Extended for the Classroom -

GRADE LEVELS
• 5-8

TIME
• 30-40 minutes

LEARNING OBJECTIVES
• Environmental pressures can cause small changes in an animal’s physiology.
• These small changes are called adaptations.
• The accumulation of these small changes over time can drastically change an animal. This is known as evolution.

MATERIALS
• Air dry clay
• Horse feet models
• Large ink pads
• Warm soap and water (for clean up)

BACKGROUND INFORMATION
• The first horse ancestor, Eohippus, appeared in North America 60 million years ago.
• Changes in the environment over time led to changes in the horses’ anatomy, especially the hoof.
• These adaptations caused by environmental pressures are integral in the evolution of the horse.
SET UP
1. On a large flat table, display the 4 horse feet models.
2. Before class starts, separate the clay into balls (about the size of a baseball).
3. Have the ink pads close by the horse feet models.

INTRODUCTION
1. Have students gather around the table and introduce the activity. Encourage the students to study the horse feet:
   a. What are some of the differences between the feet?
   b. What do you think the environment was like?
   c. Can you guess how old is the oldest skeleton?
   d. How do you imagine the horse behaved then and now? For example, what would the ancient horse do if he saw a predator (probably hide), versus the modern horse (probably run).
2. Point out the marked difference in the feet of the horses. The feet of the horses provide great insight into how the horse has evolved.
3. Tell the students that the changes in the feet of the horses provide great insight into how the horse has evolved over time.

DEMONSTRATION

Part 1: Eohippus

The following demonstration should take about 5 minutes. Ask the student to do a quick demonstration using their hands. This demonstration will show how horse feet have changed from 4 separate toes into a single hoof.

1. Talk about how the climate of North America was when the ancestors of the horse first appeared:
   a. Ancestors of the horse first appeared in North America about 60 million years ago.
   b. 60 million years ago, North America’s climate was a tropical rainforest. This means that there were plenty of trees and small plants.
   c. Ask students how they think the horse ancestors might have lived in this environment.
      - What kinds of foods might the horse have eaten?
      - What would the horses’ environment have looked like?
      - What would the ground feel like? Hard? Soft? Mushy?
2. Tell your students that the horse ancestor was well adapted to its environment. Discuss how it might look like to be adapted to its environment.
   a. Would it be tall or small?
   b. How did it evade predators?
c. How did it eat?
3. Explain that these horses were well “adapted” to living in a forest environment.
4. Have your students place their hands flat on the table top.
5. Let your students know that their hand formation represents the foot of the *Eohippus*, one of the earliest relatives of the horse. (60-45 million years ago)
   a. *Eohippus* was only about 2 feet long and 8-9 inches tall.
   b. It was an herbivore that lived in a forest habitat.
   c. Since it lived in the forest, which has softer, “squishier” ground than a prairie, the *Eohippus* had soft feet with 4 toes on each foot.
   d. The softer feet prevented the *Eohippus* from sinking into the soft ground of the forest. If the *Eohippus* would have had a sharp hoof, it would have sunk into the soft ground.

Part 2: Eohippus
1. Let your students know that our environment constantly changes, cycling between ice ages and responding to Life. The climate of North America changed about 35 million years ago.
   a. Discuss how the environment of North America changed from a rainforest to a more grassland environment.
   b. Some forested areas remained but a large portion of North America became grassland or prairie habitat.
   c. Ask students what they think happened to the *Eohippuses* that lived in the forest.
      - Did they all become extinct?
      - Did they move?
      - How could they change to adapt?
   d. Explain that these forest horses changed, or “adapted” to living on the prairie.
2. Starting with their hands flat against the table, have the students place only 3 fingers on the table. This should cause the students’ wrists to rise up a few inches.
   a. Discuss that the hand formation represents the *Mesohippus*.
   b. The *Mesohippus* was a little bigger than the *Eohippus*, standing about 2 feet tall.
   c. The *Mesohippus* was a grazer that browsed on the new grasses on the prairie.
   d. Because of the changing climate and environments, the *Mesohippus* evolved to have only 3 toes, and stood predominantly on its middle toe.
   e. Even though *Mesohippus* evolved to only have 3 toes to accommodate the new terrain found on the prairie, they still had soft tissue, not the hard hoof seen in modern horses.
f. Also mention that just like the students’ wrists moved up in the air when they placed 3 fingers on the table, the *Mesohippus*’ ankle also rose up in the air but was supported by strong ligaments and tendons connected to the toes.

**Part 3: The Modern Horse**

1. Introduce the evolution of the hoof in modern horses:
   a. During the 24 million years that followed, the horse continued to live in a prairie-like and grassland environment.
   b. Ask students what they think happened to the horses to that lived in the prairie.
      - Did they all become extinct?
      - Did they move?
      - Did they change in someway? Adapt?
   c. Explain that these prairie horses continued to change, or “adapt” to living on the prairie.

2. Now have the students make a fist and place it knuckle-side down on the table.

3. This represents the hoof of a modern day horse.
   a. About 11-4 million years ago, a new horse emerged. This horse is called, *Equus*, and is the modern horse you know today.
   b. *Equus* was about 5 ½ - 6 ft tall and ate grass almost exclusively.
   c. After living on the prairie for such a long period of time, *Equus*’ foot evolved from the 3 soft toes of *Mesohippus*, to a single hoof made of hardened keratin. Keratin is the same substance that makes up your hair and fingernails.
   d. The hoof of *Equus* is actually just a large flattened out middle toe. It has lost all of its other toes.
   e. Because the prairie has such hard ground, the large hard hoof makes it easier to run, compared with the soft toes of the *Mesohippus*.

4. Encourage the students to revisit their initial guesses about the different horse ancestors:
   a. Now we know some reasons why the foot changed. Are there other changes in the horse that now make sense? *For example, the legs became longer so the horse can run faster. The neck became longer so it can reach the grass on the ground.*
   b. Can you think of differences and similarities between how the horse behaved then and now? *For example, what would the ancient horse do if he saw a predator (probably hide), versus the modern horse (probably run).*
ACTIVITY – Making a Horse Foot Mold

1. **SET UP:** Separate modeling clay into appropriate amounts. Each portion should be big enough so that when flattened, the model of the horse foot will have room to be placed in the center of the clay.

2. **OPTIONAL SET UP:** If possible, make a set of foot prints of all the horse feet ahead of time and display.

3. Give each student a portion of modeling clay.

4. Pass out a portion of clay to each student.

5. Encourage students to gently touch the model horse feet and explore their differences and similarities. Help the groups discuss how what they have learned is represented by each model (the horse’s habitat, when it lived, how it avoided predation, likely behaviors, etc).

6. Have each student choose the model they would like to make a print of.

7. Have each student make a horse print: stamp the chosen foot on the ink pad, then carefully press the hoof into the clay.

8. Discuss as a class the different prints visible in the clay:
   a. Note the different number of toes that touch the ground and are captured in the clay.
   b. Help your students remember that the eohippus lived on soft ground and its feet were adapted to sinking into it, while the modern horse is adapted to a harder ground, and its single hoof is a hard material that doesn’t sink easily.