Natural Selection and the Horse

Styles change. Music changes. Cars change. Even living things change. We call change through time evolution. Fossils are the visible remains of prehistoric organisms. They provide evidence that life existed in a different form at one time. However, a few fossils cannot give you a complete story. You only have evidence that life existed a long time ago, and that it was different. How can fossils show that living things have changed their forms through time?

Part A. Horse cheek teeth span

Fossil evidence is rather plentiful in the case of the horse. There are fossils of horses or horse-like animals from as far back as 70 million years ago. The span of the cheek teeth has been measured in many of these fossil remains. As shown in the sketch the cheek teeth are found on the side of the jaw and are the large grinding teeth.

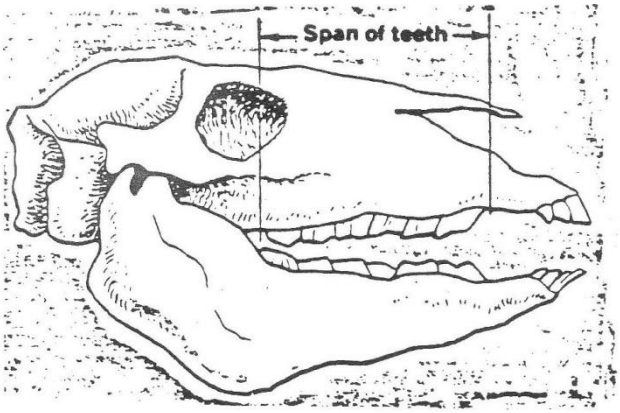


Table 1

Group	Time of Existence, Millions of Years Ago	Span of Cheek Teeth in cm
Eohippus	70	4.3
Orohippus	50	4.3
Epihippus	45	4.7
Mesohippus	35	7.3
Miohippus	30	8.3
Parahippus	25	10.0
Merychippus	15	12.5
Pliohippus	7	15.6
Equus	1	17.6

The data for each horse group and its time of existence are shown above in Table 1.

Construct a Graph of Table 1 using the following instructions:

- Give your graph a title.
- Label the horizontal (bottom) axis as “Time, millions of years ago” and start with 70, then 60, and continue to the right by tens down to 0.
- Label the vertical (upright left side) axis “Span of cheek teeth, cm.” and label from 0 to 20.
- Plot a point on the graph for each of the horses in Table 1. Label each point with the name of the horse and draw a line connecting the points.

1. What does each dot on the graph represent?

2. What must be the scientific name of the present modern day horse?

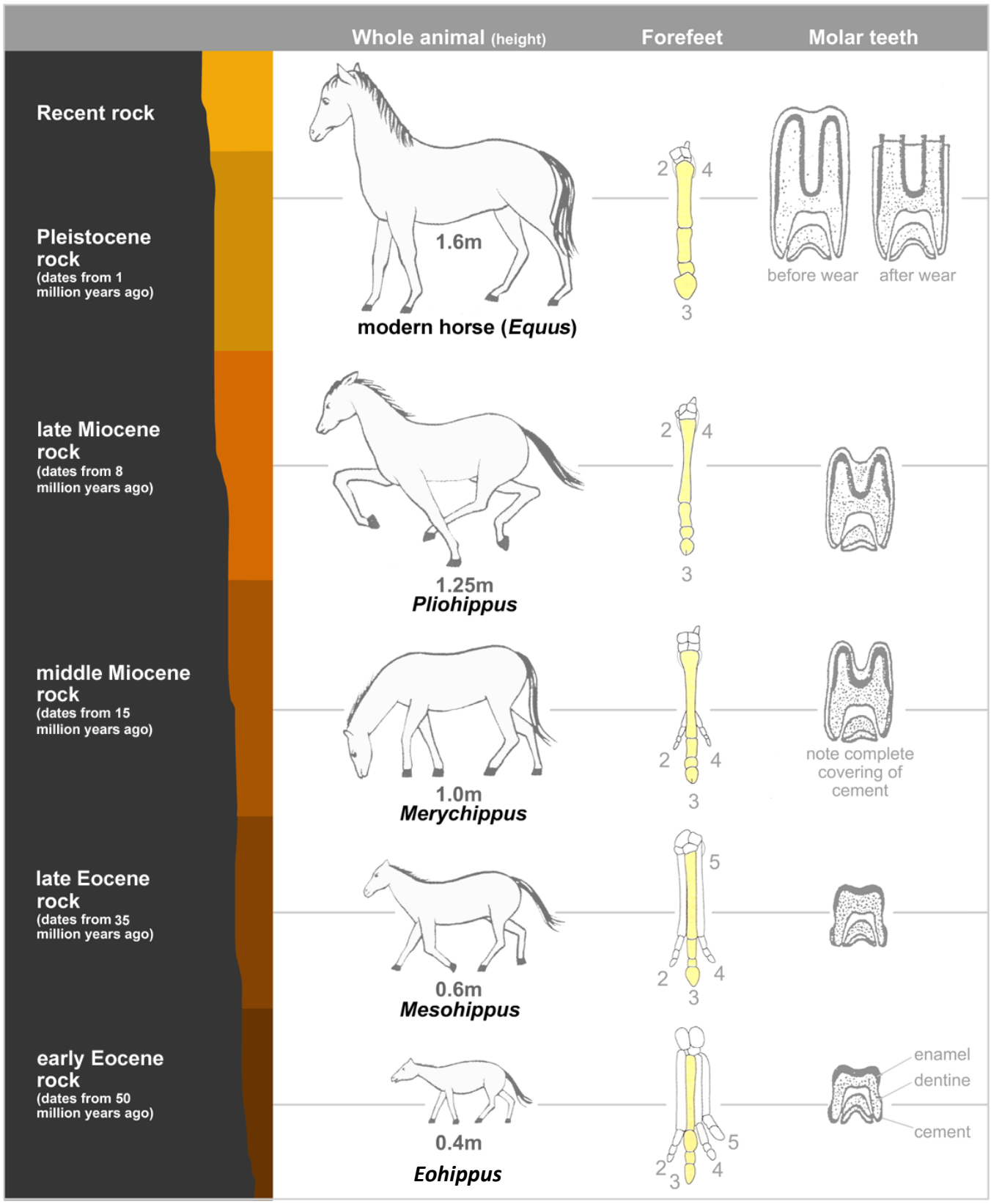
3. What is the scientific name of the oldest horse?

4. When did the oldest horse exist?

5. What was the span of the oldest horse’s cheek teeth?

6. What does your graph indicate has been happening to the span of cheek teeth through history?

7. Where have scientists gotten these cheek teeth span measurements from?


Whole animal (height)
Forefeet
Molar teeth
Recent rock
Pleistocene rock
(dates from 1 million years ago)
late Miocene rock
(dates from 8 million years ago)
middle Miocene rock
(dates from 15 million years ago)
late Eocene rock
(dates from 35 million years ago)
early Eocene rock
(dates from 50 million years ago)
1.6m
modern horse (Equus)
2
4
3
before wear
after wear
1.25m
Pliohippus
note complete covering of cement
1.0m
Merychippus
5
0.6m
Mesohippus
0.4m
Eohippus
enamel
dentine
cement

Part B. Horse leg structure

There are also many fossil remains of horse leg bones. Look at the diagram on the previous page of the front legs and toes (hooves) of some of these horse fossils.

8. Which is the oldest horse on the diagram?

9. How many front toes did the oldest horse have?

10. Which is the modern-day horse?

11. How many front toes (hooves) does the modern-day horse have?

12. What has happened to the number of toes through time?

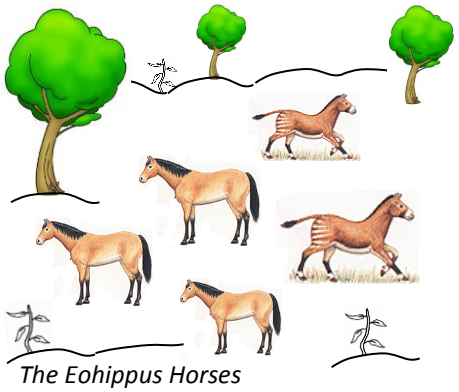
13. What has happened to the size of the toes and apparent length of legs through time?

14. Where have scientists gotten the information about the number and size of horse toes that was presented here in this lab?

15. Summarize what this group of related fossils tell us has been happening through time to the leg structure of the horse.

Part C. Natural Selection and Horse Evolution

The **evolution of the horse** involves the gradual development of the modern horse from the fox-sized, forest-dwelling *Eohippus*. Paleozoologists have been able to piece together a more complete picture of the modern horse's evolutionary lineage than that of any other animal.



The Eohippus Horses

Eohippus, which lived 70 million years ago, was a small animal. This group of animals appears to have been originally specialized for life in tropical forests. They had small body structure, small teeth, and short legs with 4 toes on each front leg and 3 toes on each hind leg which were beneficial for walking on the soft, moist grounds of primeval forests. The heavy plant growth provided these prehistoric horses a cover for protection from predators and plenty of food to eat.

As millions of years passed, the lush forest began to disappear and thin out. The lush tropical forest was gradually replaced by grassland with dry hard soil. The horse's predecessors' diets shifted from soft foliage to harder grasses. At the same time, as the plains began to appear, the horse's predecessors needed to be able to escape predators, since they no longer had the dense forest to hide in.

16. What body structure could have given some of the *Eohippus* and their surviving relatives an advantage that gave them the ability to get away from predators?

17. How did that body structure give them that advantage?

18. As the forest thinned some horses were caught by predators, but some horses also escaped and survived. These survivors became the parents of the next generation. In terms of escaping from predators, what type of offspring might these surviving parent horses have had more frequently?

As you have just learned, the horse has evolved from an animal with many toes into one with only one toe (hoof) on each leg. In addition, the legs of horses have gotten longer.

19. Explain why the number of toes and the length of the legs have changed in the horse through time. Include in your answer what you know about the survival advantage, environmental change, and natural selection.

Part C. Changes in tooth structure

In addition to losing its forest protection, *Eohippus* found a change in its food supply. The supply of soft forest-type leaves was slowly replaced by harder grasses, which grew where the forest and beach used to be.

20. Describe the kind of teeth horses would have to have the best survival chance with the new food.

21. In terms of tooth structure, what kind of offspring would the surviving horses tend to have?

As you have just learned, the horse has evolved from an animal with a small span of teeth into one with a larger span of teeth. The teeth themselves changed from being relatively long and thin to becoming short, large, blunt and stubby. As the tooth size increased, the span of cheek teeth also increased.

To help you answer the next question, think about your own teeth. Your front teeth are long and thin. What are they good for? Your back teeth are shorter, larger, and stubbier. What are they good for?

22. Explain <u>why</u> and <u>how</u> the size of the teeth and the span of the cheek teeth changed in the horse over a long period of time.

23. Using your graph, at what time did the food supply probably start to change?

24. What is the name of the <u>theory</u> and who was the <u>scientist</u> that came up with the theory used to explain the evolution of the horse in this lab?