

Name: \_\_\_\_\_

## Natural Selection – Option 3

### Mice Living in a Desert

1. What is happening in these figures? Describe how the population of mice is different in figure 3 compared to figure 1. Explain what happened to cause this difference.

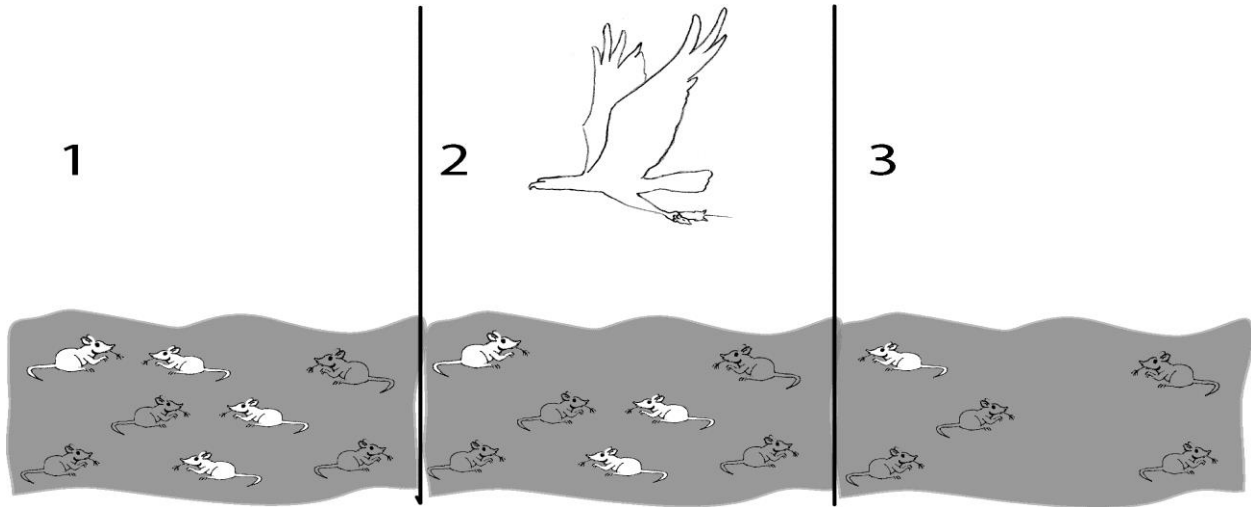
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An **adaptation** is any characteristic that increases **fitness**, which is defined as the ability to survive and reproduce.

2. For the mice in the figure, what characteristic was an adaptation that increased fitness?

Suppose a population had three female mice with the following characteristics.

Characteristics of each female mouse	Color of Fur		
	White	Gray	Black
Running speed	5 cm/sec.	6 cm/sec.	8 cm/sec.
# offspring produced by each female	5	19	8
Age at death	3 months	6 months	3 months

3. According to the definition of fitness given above, which of these mice would be the fittest? Explain why this mouse would be the fittest.

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4. If a mouse's fur color is generally similar to its mother's fur color, which fur color would be the most common among the offspring? \_\_\_ black \_\_\_ gray \_\_\_ white  
A characteristic which is influenced by genes and passed from parents to offspring is called a **heritable trait**. Fur color is a heritable trait for mice.

In general, individuals with a heritable trait that increases fitness produce more offspring than individuals that do not have this trait. Because the trait is heritable, offspring resemble their parents, so more of the offspring will have this adaptive heritable trait. Therefore, over time, adaptive heritable traits tend to become more common in a population. This process is called **natural selection**.

**5a.** Suppose that one day while the mice were sleeping in their burrows, the gray sand is replaced by white sand. (Perhaps the owner of the desert has a plan to attract more tourists.) Think about what would happen to the population of mice on the white sand. After a year, which color fur do you think most of the mice would have? \_\_\_ black \_\_\_ gray \_\_\_ white

**5b.** Explain how the change in the color of the sand could eventually result in a change in the most common fur color in this population of mice.

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**6.** When mice live on gray sand, which color fur is an adaptive heritable trait?

When mice live on white sand, which color fur is an adaptive heritable trait?

Notice that which trait is adaptive differs in different environments.

**7.** What is natural selection? As part of your answer, explain why an adaptive heritable trait tends to become more common in a population.

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### III. Natural Selection in Action – The Peppered Moth

**8.** These photos both show the two major forms of the peppered moth. Can you find the speckled form of the peppered moth on the lichen-covered tree trunk shown below? Can you find the black form of the peppered moth on the tree trunk that has been darkened by air pollution? Circle these two “camouflaged” moths.



Peppered moths are active at night. During the day peppered moths rest on tree trunks and branches. Some of these resting moths are eaten by birds. Researchers have found that mortality is higher for the speckled form of the peppered moth in one type of environment, and mortality is higher for the black form of the peppered moth in a different type of environment.

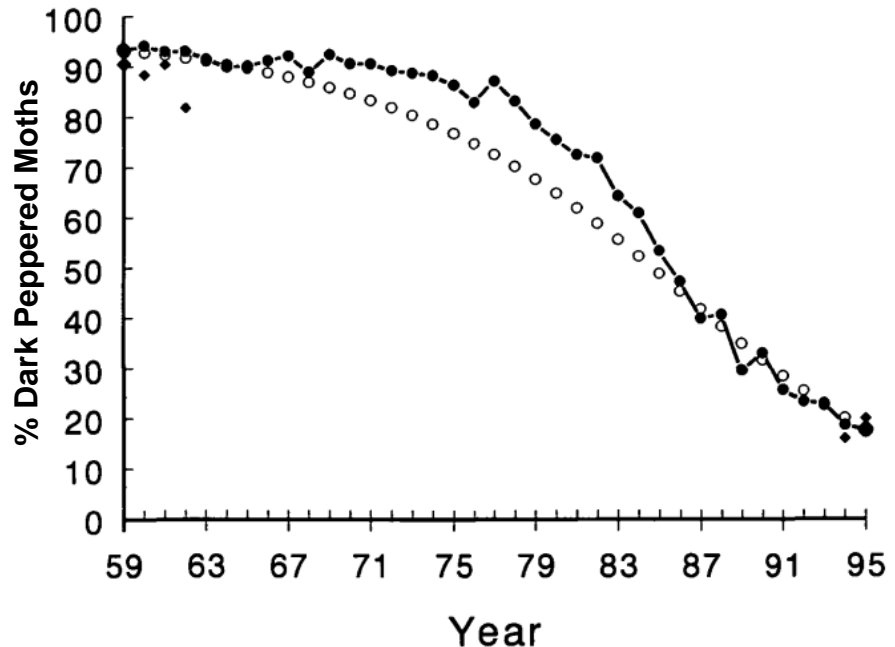
**9a.** Which form of the peppered moth do you think had higher mortality in forests in unpolluted areas where tree trunks and branches are lighter? \_\_\_black \_\_\_ speckled

Which form of the peppered moth do you think had higher mortality in forests in areas where air pollution had resulted in dark tree trunks and branches? \_\_\_ black \_\_\_ speckled

**9b.** Explain your reasoning.

Natural selection has occurred in peppered moth populations. The black form of the peppered moth was very rare in England before 1850. After that date, industrialization resulted in air pollution which darkened tree trunks and branches. In industrialized areas with dark tree trunks and branches, the frequency of black peppered moths increased and speckled peppered moths became rare. The trend in southeastern Michigan was similar, although industrialization began later; no black peppered moths were observed before 1929; by the 1950s more than 90% of peppered moths were black.

Beginning in the late 1950s, government regulation resulted in decreased air pollution. Consequently, tree trunks and branches became lighter. As would be expected, there was a decrease in the percent of peppered moths that were black. This decrease is shown for one area in England (black dots) and one area in Michigan (diamonds for 1959-1962 and 1994-1995).



<http://jhered.oxfordjournals.org/content/87/5/351>

The open circles in the graph represent the trend predicted by a model of natural selection which

incorporated experimental estimates of higher mortality rates for black peppered moths in unpolluted environments.

**10.** Write an explanation of what happened to cause the trends in the proportion of black peppered moths.

**11.** Use the example of black vs. speckled forms of the peppered moth to explain the following generalization: Natural selection acts on individuals, but only populations evolve.

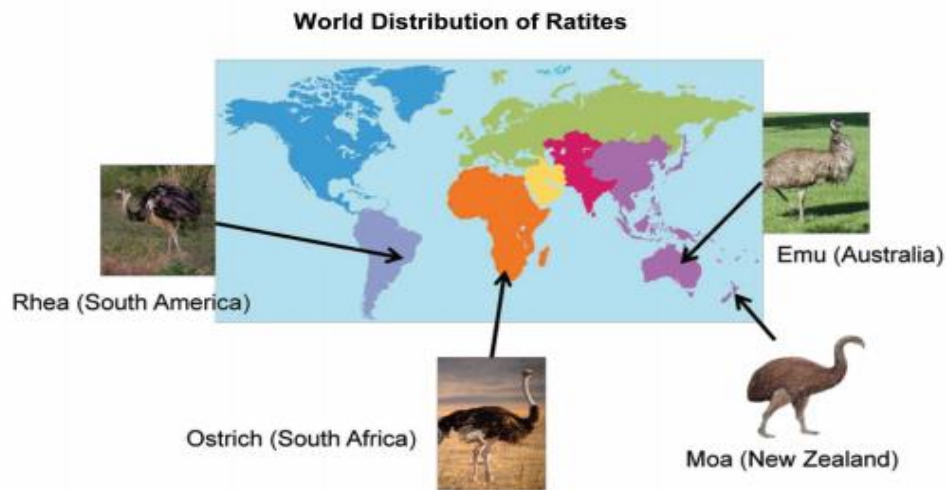
# Biogeography

## *Flightless birds*

These birds belong to the family of birds called ratites. Included is the largest bird ever on earth, the moa which lived in New Zealand. The moa is extinct. There are 3 other extant species on earth, ostriches in South Africa, emu in Australia and the rhea in South America.

All ratites share the following characteristics:

- Flat sternum
- Small wings
- Large bodies
- Heavy leg bones
- Strong feet
- No opposable first toe



What do we call the geographical distribution of animals and plants over space and time?

- A Evolution.
- B Biogeography
- C Continental drift
- D Homology

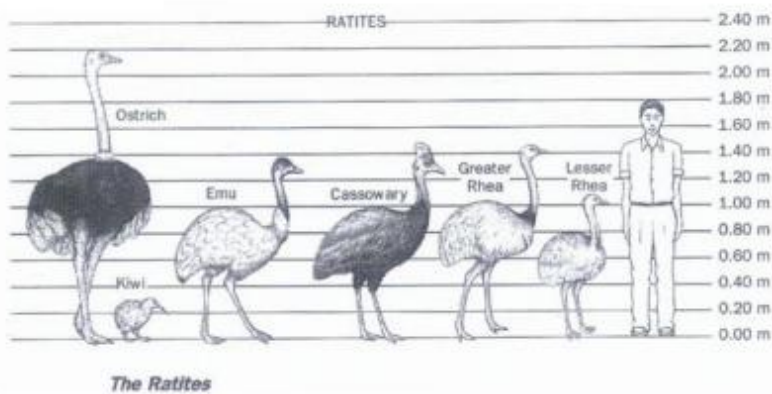
Which one of the following is NOT characteristic of ratites?

- A Flat sternum
- B Large wings
- C Large bodies
- D Heavy leg bones

Which one of the following flightless birds has become extinct?

- A Moa
- B Rhea
- C Emu
- D Ostrich

Ratites are flightless birds and although they can be found widely distributed across the globe, scientists believe that they evolved from a common ancestor as they resemble each other.



List THREE ways in which ratites differ from birds which can fly.

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_

If the ratites did indeed evolve from a common ancestor, explain how it is possible for them to be as widely distributed as the map below indicates.

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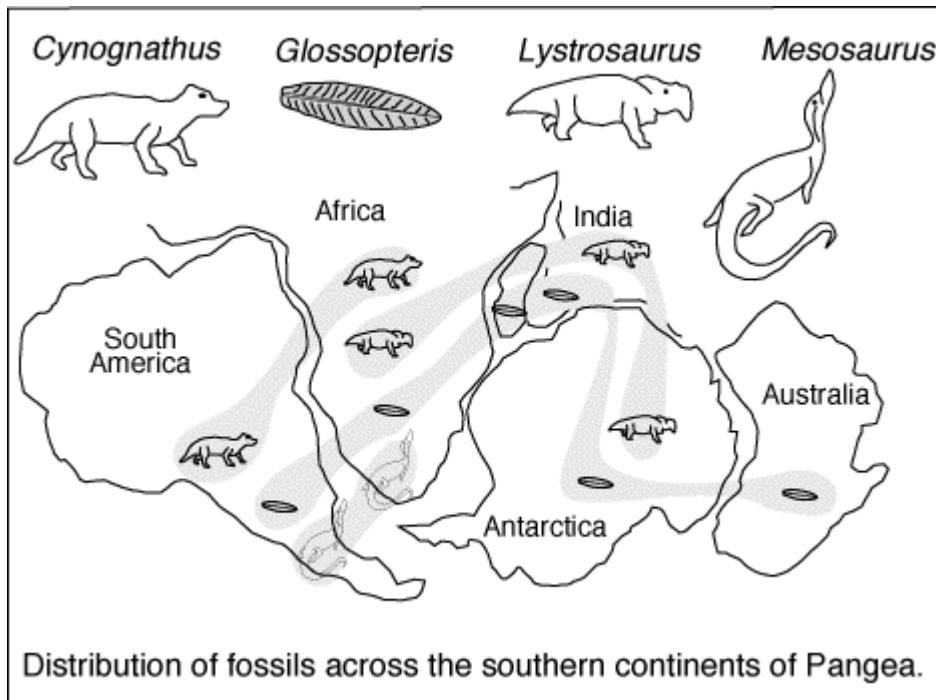
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According to the map, where is the smallest ratite found?

Carefully study the diagram of Southern Pangea below.



1. On what continents are fossils of the *Cynognathus* found?
2. On what continents are fossils of the *Lystrosaurus* found?
3. Which fossil is found on all 5 continents?
4. How does fossil evidence support the idea of Pangea?