

Natural Selection Simulation

at PHET http://phet.colorado.edu/simulations/sims.php?sim=Natural_Selection (link is also posted on Evolution Unit page at www.biologybynapiet.com)

Exploration: Access the simulation and explore the settings. Answer the following questions:

1. What are some VARIABLES that you have control over in the simulation?
2. What happens to the bunny population if a friend is never added? What happens when you add a friend?
3. What happens when you add food as a selection factor?
4. What is a genetic mutation? What are the three mutations you can add to your bunny population?



Experiment A - Does brown fur provide an advantage?

- a. Add a friend and a brown fur mutation to the bunny population, let the experiment continue to its conclusion.
 - b. Start over and add brown fur mutation (with friend) but add a selection factor of wolves when your bunnies start to get overpopulated. Let the experiment run until you have a clear idea of what is happening with the rabbit and wolf populations.
 - c. Change the settings so that you still have brown fur mutations but this time remove the wolves and make the selection factor be food. Let the experiment run until you have a clear idea of what is happening within the population.
 - d. Reset and change the settings so that you have brown fur mutation in an arctic environment, use wolves as your selection factor.
6. Based on the four simulations you ran, describe what happened to your population and answer the experimental question "Does brown fur provide an advantage?" Provide evidence from the simulation to support your conclusions. **(ANSWER IN COMPLETE SENTENCES)**



Experiment B - Does long teeth provide an advantage?

7. Following the guidelines from the Experiment A, determine when long teeth provides an advantage to the bunny population. Based on your tests showing long teeth in a variety of situations, determine when long teeth provide a selective advantage. Provide evidence from the simulation to support your conclusion. **(ANSWER IN COMPLETE SENTENCES)**

Experiment Challenge

8. Using the simulation, determine the conditions when a long tail would be an adaptation. If you cannot discover this from the simulation, propose any possible situation where a long tail would provide a selective advantage for bunnies and explain WHY it would be an advantage. **(ANSWER IN COMPLETE SENTENCES)**

Post-Lab Analysis (ANSWER IN COMPLETE SENTENCES)

9. Define variation. What genetic variations are presented during this simulation?

10. Define adaptation. Give examples when an adaptation is beneficial to the bunnies.

11. What are 3 other (natural) selection factors which effect animal populations in the real world?

12. If a bunny population was forced to move to a desert environment, how might natural selection have an effect on the population over time?

12. How has this simulation added to your knowledge of evolution (the study of life's history and its change over time)?

Read the following situations below and identify the 5 points of Darwin's natural selection.

- 1) There are 2 types of worms: worms that eat at night (nocturnal) and worms that eat during the day (diurnal). The birds eat during the day and seem to be eating ONLY the diurnal worms. The nocturnal worms are in their burrows during this time. Each spring when the worms reproduce, they have about 500 babies but only 100 of these 500 ever become old enough to reproduce.



a. What worm has natural selection selected AGAINST? _____

FOR? _____

- b. Darwin's 5 points: Identify the 5 points in the scenario above.

Population has variations. _____

Some variations are favorable. _____

More offspring are produced than survive. _____

Those that survive have favorable traits. _____

A population will change over time. _____

- 2) There are 3 types of polar bears: ones with thick coats, ones with thin coats and ones with medium coats. It is fall, soon to be winter. The temperatures are dropping rapidly and the bears must be kept warm, or they will freeze to death. Many of the bears have had ~2 cubs each but due to the extreme temperatures, many mothers only have one cub left.



a. What bear will natural selection select AGAINST? _____ FOR? _____

- b. Darwin's 5 points: Identify the 5 points in the scenario above.

Population has variations. _____

Some variations are favorable. _____

More offspring are produced than survive. _____

Those that survive have favorable traits. _____

A population will change over time. _____

3) In ostriches, there are 2 types: ones that run fast and those that run slowly. The fast birds can reach up to 40 miles an hour. Jackals love to eat ostrich, and they can reach speeds of up to 35-40 miles per hour. A flock of ostrich will lay ~ 10 eggs (each mother only lays 1), but many rodents break into the eggs and eat the fetus before they hatch.



a. What ostrich will natural selection select AGAINST? _____ FOR? _____

b. Darwin's 5 points: Identify the 5 points in the scenario above.

Population has variations. _____

Some variations are favorable. _____

More offspring are produced than survive. _____

Those that survive have favorable traits. _____

A population will change over time. _____

4) There are two types of rabbits: those that strictly eat grass and those that strictly eat berries and flowers. A drought occurs one year, and the plants have difficulty producing any extras (flowers, berries, etc.). They can only try and keep themselves green. The rabbits have had babies all year long but many are eaten by foxes or hawks. Due to the drought, many have starved to death.



a. What rabbit will natural selection select AGAINST? _____ FOR? _____

b. Darwin's 5 points: Identify the 5 points in the scenario above.

Population has variations. _____

Some variations are favorable. _____

More offspring are produced than survive. _____

Those that survive have favorable traits. _____

A population will change over time. _____

5) Bob believes that giraffes have long necks because they have stretched their necks to try and reach food that is high in trees. Since the parent had stretched its neck, it passed the long neck on to its offspring. Ryan believes that giraffes have long necks because the ones with long necks were able to reach the food, and those with short necks could not and died. The long necked giraffes reproduced, and soon all of the giraffes had long necks.



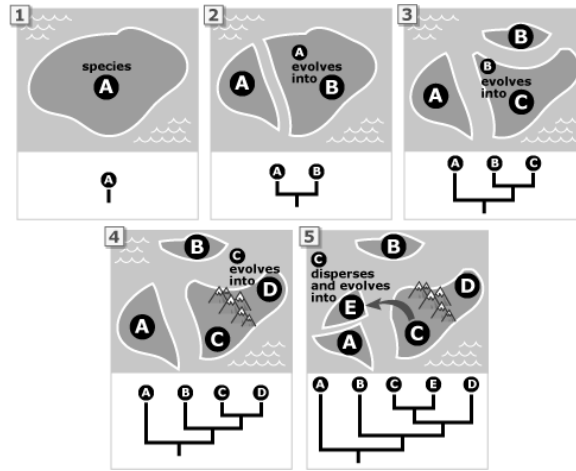
a. Who thinks like Lamarck? _____

b. Who thinks like Darwin? _____

~EVOLUTION OF ELEPHANTS~

Biogeography

Biogeography is the study of the geographical distribution of living things. This can lead to one species evolving into two or more different species. Take a few minutes to study the image below.



Elephants can be viewed as a modern day example of biogeography. Read the following article and answer the questions that accompany it.

Are the African elephants separate species? Scientists find new species all the time, but you'd think that the largest land mammals on Earth wouldn't be that difficult to spot. However, as biologists use new techniques for studying classification, sometimes their thinking changes.



African Elephant (Savannah)

African Elephant (Forest)

Asian Elephant

Biologists have known for more than 100 years that there are two species of elephants in Asia (*Elephas maximus*) and Africa (*Loxodonta Africana*). In Africa, one population of elephants lives on the savannah, while the other is a forest-dweller. Until now, scientists have classified them as the same species, based on their belief that they freely interbred at the margins of their ranges.

Recently a group of scientists studied DNA variation in four genes in 21 elephant populations. As expected, the data indicated a 58% difference between the African and Asiatic species. They found that there was more than half that difference between the African savannah populations and the African forest-dwelling populations. Further studies found that the two African elephant groups interbreed only occasionally. Since the Asiatic elephant and African elephant are in separate genera, the scientists propose that the African elephants should be reclassified as two separate species. These would be *L. africanus*, the savannah population, and *L. cyclotis*, the forest-dwelling population.

Answer questions #1-5 before reading the next article.

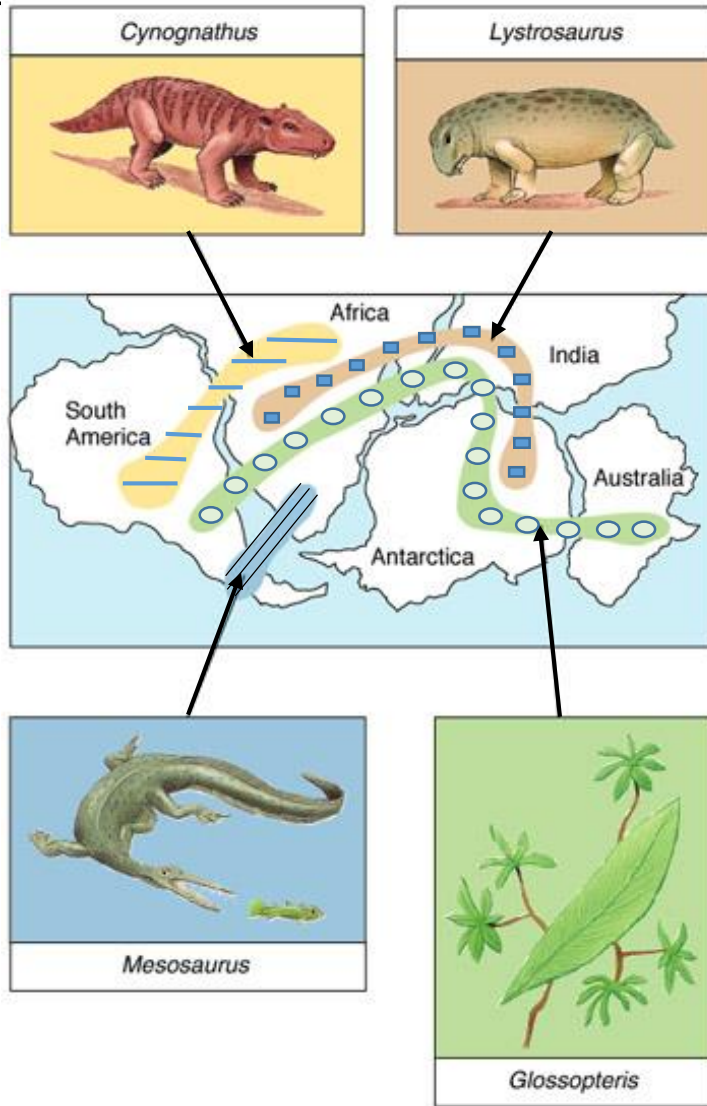
1. What often changes the thinking of scientists?
2. On what two continents do Elephants live?
3. What did the study of DNA variation tell scientists about the relationship between the Asian and African species?
4. Why do scientists now believe that the African elephants (forest dwellers and savannah dwellers) should be classified as two different species? Give two reasons!
 - a.
 - b.
5. How is this an example of Biogeography?

Tuskless Survivors

A new study says that more male Asian elephants in China may be born without tusks because poaching of the pachyderms is thinning out the gene pool that creates tusks in the animals. The China Daily reports that the tuskless gene, which normally existed in Asian elephants at a rate of 2 to 5 percent, has increased to 5 to 10 percent in China among males of the species. Research by Zhang Li, an associate professor of zoology with the college of life sciences at Beijing Normal University, found that the gene for "tusklessness" is spreading among the endangered species in its habitat in Yunnan province of southwest China. "This decrease in the number of elephants born with tusks shows the pressure that poaching for ivory is having on the animal," said Zhang.

1. What is happening to newborn male Asian elephants?
2. How has poaching affected the Asian elephants?
3. By what percent has the tuskless gene increased in the Asian elephant population?
4. How could this gene be beneficial to these elephants?
5. If the trend continues, what may happen to the Asian elephant population?
6. Can human actions influence evolution? _____ Explain.

Carefully study the diagram of Pangea below. The locations that these four different fossils have been found has been marked



Use this image and your knowledge of biogeography to explain why fossils of the same species have been found on continents oceans apart. Use complete sentences.

Get checked off and signed off before moving on _____