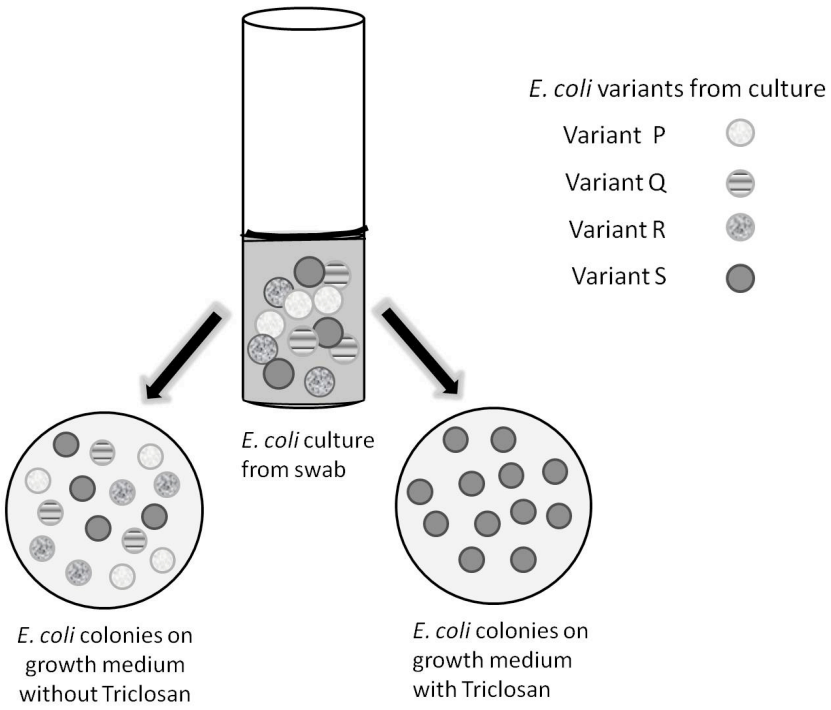
Evolution and Selection

What mechanisms lead to diversity of species on Earth?

Why?

The idea of selection involves a variety of options with one option coming to the forefront while other options are eliminated. Humans choose options by deciding what they like best; the natural world also selects options (but not by "thinking" about them) when the environment acts on genetic diversity. In this activity, we will explore how selection affects populations.

Model 1 – Desk Swab Results



A desktop was swabbed to collect bacteria. E. coli *were found and were grown as shown.*

1. How many genetic variants of *E.coli* were present in the culture from the initial swab?

2. What variants of *E. coli* are found on the dish without Triclosan?

3. What variants of *E. coli* are found on the dish with Triclosan?

4. What happened to the other variants of *E. coli* on the dish with the medium containing Triclosan?

5. Based on its effect on *E. coli*, why is Triclosan used as a cleaning agent?

6. Suppose the desktop swabbed earlier were cleaned with a solution containing Triclosan. Would living *E.coli* remain? Support your answer.

7. Suppose that the desktop were swabbed again after cleaning it with Triclosan over a 9 month school year.
    a. Would you expect to find the same *E. coli* variants as the initial swab? Why or why not?

    b. What happened over the 9 month period to the number of variants of *E. coli* present?

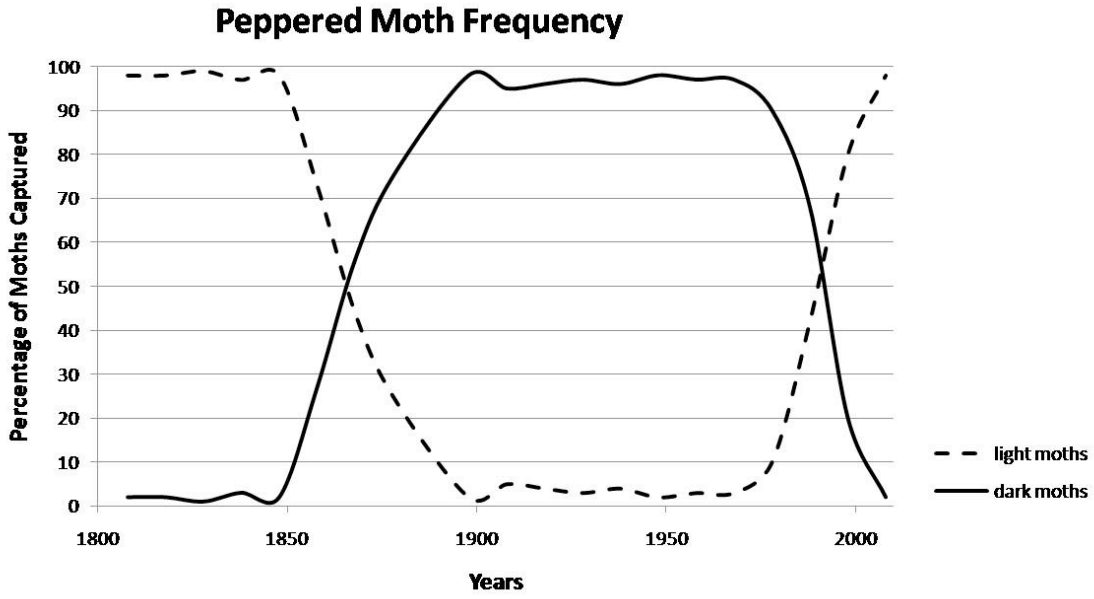
Read This!

Populations of most living organisms contain individuals with genetic diversity. Some of the traits in this diversity give the individuals that possess them a greater chance at survival than individuals that lack the traits. Because the traits tend to increase survival, these individuals produce more offspring, which also have the trait that favors survival. In the population, over time, the number of individuals with this favorable trait increases while the number of offspring with the unfavorable trait decreases.

8. What is the favorable trait that might allow variant S to remain on the tabletop even after several months' treatment with triclosan?

9. What explanation can you offer for why the types of *E. coli* found on this surface would change over several months' period?

Model 2 – Color Variations in Moths in Great Britain



10. Describe the change in the number of light colored moths over the whole time period shown.

11. Describe the change in the number of dark colored moths over the whole time period shown.

12. Describe the change in the numbers of light colored moths and dark colored moths between 1850 and 1900.

13. Describe the change in the numbers of light colored moths and dark colored moths between 1950 and 2000.

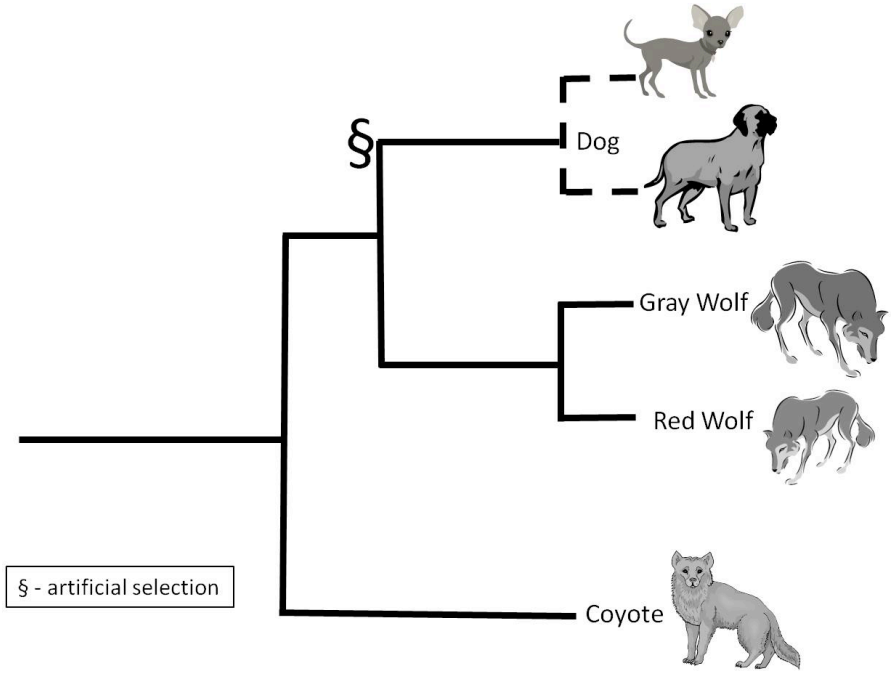
14. During the Industrial Revolution and up through the mid-20th century, factories and power plants which burned coal produced large quantities of soot and smog. Near industrialized areas, black powder covered surfaces, including the moth habitat.
    a. Which color moth would have a better chance of surviving predation on this dark surface?

    b. How does this help explain the change in the colors of the moth population shown in Model 2?

15. Clear Air Acts were passed by governments of industrialized nations beginning in the mid-1950s. Use this information to explain why the color of the moth population shifted again.

16. In one or two grammatically correct sentences, summarize how the environment influenced the color of the moth population in this area of Great Britain.

Model 3 – Natural vs. Artificial Selection



17. Model 3 traces the lineage of what organisms?

18. How does Model 3 indicate that all three types of organisms came from a common ancestor?

19. Of the three different kinds organisms listed in the model, which groups are most closely related?

20. Thinking about the characteristics of the organisms above, what are some differences that you note between wolves and dogs? What similarities can you identify?

21. Dogs were domesticated and bred from wolves by early humans. What traits might humans have selected in the common ancestor of dogs and wolves that would account for the differences between dogs and wolves?

22. Despite their vast differences, all breeds of dogs are members of the same species, *Canis familiaris*. Choose a dog breed and describe the traits that humans selected when breeding for it.

23. The biggest difference between red and gray wolves is their color. What environmental conditions might have selected for red wolves and gray wolves?

24. At one time, gray wolves were distributed across the western and northern areas of North America while red wolves were primarily found in southeastern states and along the East coast. By the beginning of the 21st century, red wolves were generally believed to be extinct in the wild. What part might selection have played in this drastic decrease in red wolf population?

Read This!

The events that lead to changes in groups of organisms are called **selection** by evolutionary biologists. Charles Darwin is the person credited with carefully outlining how various changes in organisms might build up through time. He called this process **natural selection**. Humans participate in selection through selective breeding of plants and animals. This is referred to as **artificial selection**.

25. Use the words *selection* and *traits* to propose how the separation of the ancestors of modern wolves and dogs from the ancestors of coyotes explains the distance of relationship between them. How could this lead to the development of three different kinds of organisms?

26. According to the model, what led to the changes that occurred between the dog and gray wolf?

27. Is the selection that led to the development of wolves and coyotes an example of natural selection or artificial selection? Explain your choice.

28. Going back to Model 1, is the selection leading to changes in the *E. coli* variants natural or artificial selection? Explain your choice.

29. Going back to Model 2, is the selection of moths that blend in to their environment an example of natural or artificial selection? Explain your choice.

Extension

30. For the past 10 to 25 years, farmers have planted crop seeds that have been genetically modified to withstand treatment with a common weed killer called Roundup®. This allows the farmers to spray their fields to get rid of weeds without harming their crops. Recently, more and more farmers have discovered that their fields have Roundup®-resistant pigweed growing along with their crop. Use what you've learned in this activity to explain how this came about.

31. Many popular products from hand soap to clothing advertise that they have antibacterial activity. Most microbiologists recommend against their routine use in our daily lives. How can you explain this using your knowledge from this activity?