

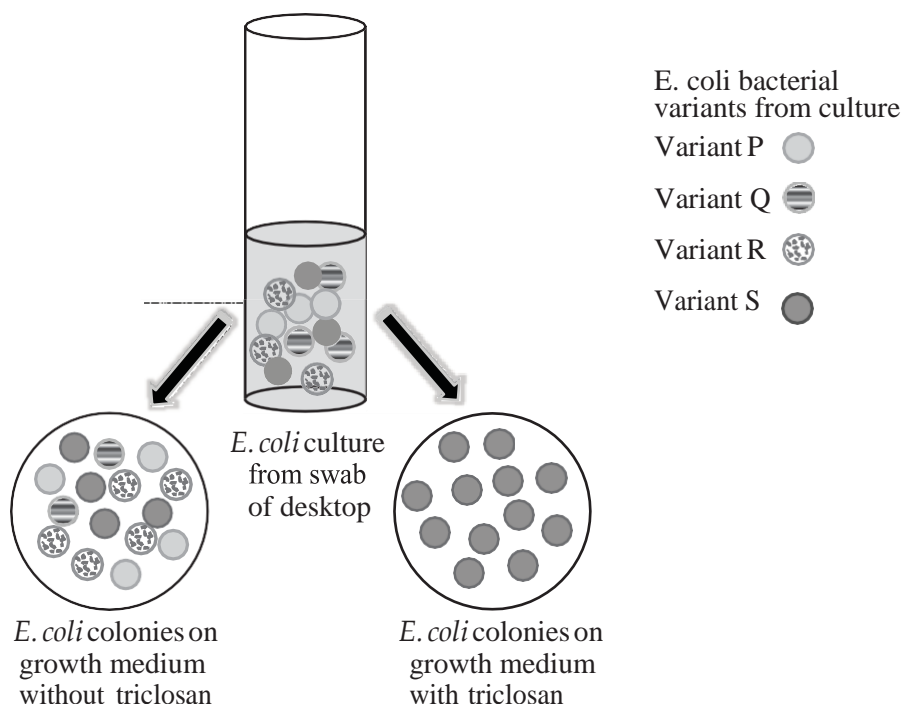
# Evolution and Selection

What mechanisms lead to changes in the diversity of species on Earth?

## Why?

People make choices by selecting options they like best. The natural world also “selects” (although not as a conscious decision) when environmental conditions allow organisms with a particular genetic trait to live healthier lives than other organisms. In this activity, we will explore how selection affects populations over time.

## Model 1 – Desktop Swab Results



1. What is the source of the bacteria in the culture tube in Model 1?

The bacteria in model 1 comes from the top of a desktop so it most likely came from human sources that have contact with the desk top.

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

There were four genetic variants of *E. coli* present in the initial swab.

3. What variants of *E. coli* are found on the dish grown without triclosan?

All four variants of *E. coli* are found on the dish grown without the triclosan.

4. Refer to the dish in Model 1 with the medium that included triclosan.

a. What variants of *E. coli* are found on the dish grown with triclosan?

The only variant of *E. coli* found on the dish grown with triclosan is Variant S.

b. What likely happened to the other variants of *E. coli* on the dish with the medium containing triclosan?

The other bacteria was likely killed by the triclosan.

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

Triclosan is used as a cleaning agent because it kills most variants of bacteria.

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

If the desktop was cleaned with a solution containing triclosan, some living *E. coli* would remain because Triclosan does not kill all variants of *E. coli*. The diagram above shows that 1 variant will survive.

7. Suppose the desktop was swabbed again after cleaning it with triclosan over a 9-month school year. When the sample was cultured only variant S was seen.

a. What characteristic does the variant S bacteria have that allows it to remain on the desktop even after several months of treatment with triclosan?

The variant S bacteria is resistant to triclosan so it will continue to survive and reproduce, even though you clean it regularly.

b. Is it likely that the bacteria in the new swab were on the desk 9-months ago, or are they offspring of the original bacteria?

The bacteria on the new swab are likely offspring of the original bacteria.

c. Propose an explanation for the presence of only variant S on the desktop after so much time.

The variant S bacteria is resistant to the triclosan and can therefore continue to live and reproduce over long periods of time.

## Read This!

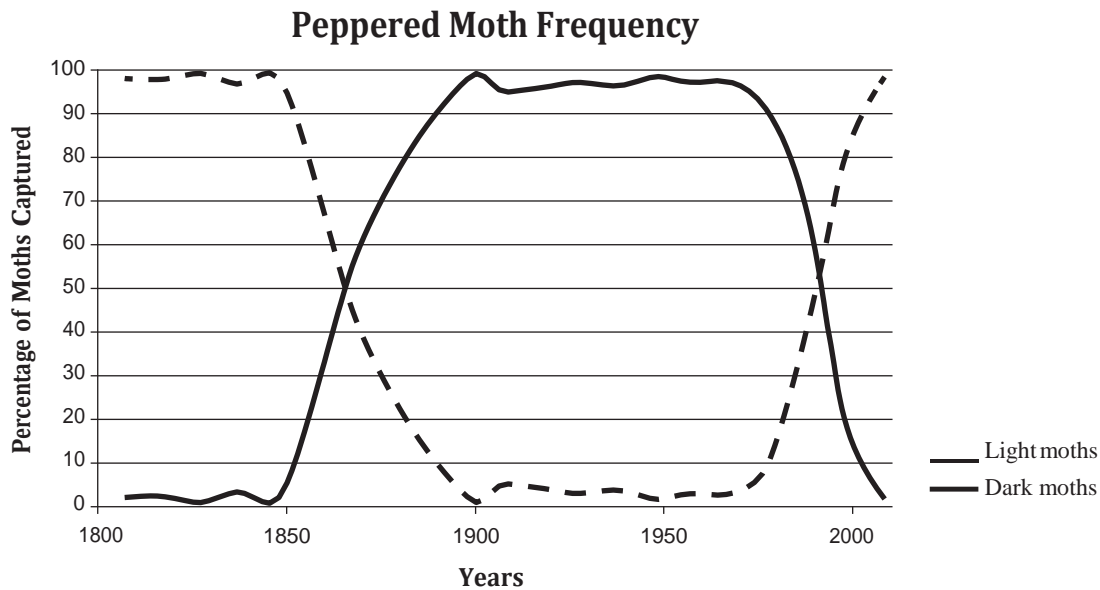
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Populations of most living organisms exhibit genetic diversity among individuals. Certain traits in a population give some organisms a greater chance of survival than individuals that lack these traits. Because these traits tend to increase the chance of survival, these individuals may produce more offspring that will also have the trait that favors survival. Over time, the number of individuals within the population possessing the favorable trait increases while the number of offspring with the unfavorable trait decreases.

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## Model 2 – Color Variations in Moths in Great Britain



8. Refer to the graph of Peppered Moth Frequency in Model 2.

a. Which moth color was more prevalent before 1850?

Light colored moths were more prevalent before 1850.

b. Which color was more prevalent between 1900 and 1950?

Dark colored moths were more prevalent between 1900 and 1950.

9. Describe the change in the percentage of light-colored moths and dark-colored moths between 1850 and 1900.

The percentage of light colored moths greatly decreased while the percentage of dark colored moths greatly increased during this time.

10. Describe the change in the percentage of light-colored moths and dark-colored moths between 1950 and 2000.

The percentage of light colored moths greatly increased while the percentage of dark colored moths greatly decreased during this time.

11. During the Industrial Revolution 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 (better camouflage to hide from predators) on this dark surface?

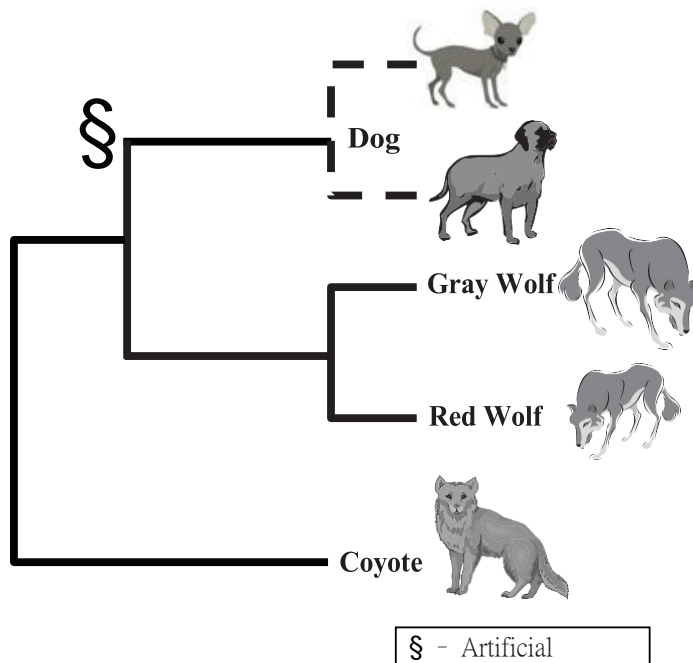
The dark colored moths would have a better chance of surviving on this dark surface.

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

The moths changed color because the environment changed. The dark moths were able to live long enough to reproduce and pass along their traits to their offspring, while the light colored moths were easy to see and therefore easy prey.

12. Clean 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. During the 1950's, the clean air act forced factories, etc. to reduce the amount of soot and other pollutants they were spewing into the atmosphere. Since the amount of soot and smog decreased, the habitat for the moths went back to its original coloring, allowing the light colored moths to blend in and survive predation. This in turn made the dark colored moths easily seen, and therefore easier to eat. Since they were no longer living long enough to pass along the trait, their numbers decreased significantly.

### Model 3 – Natural vs. Artificial Selection



13. Model 3 traces the lineage of what organisms?  
 Model 3 traces the lineage of dogs, wolves, and coyotes.
14. How does Model 3 indicate that all three types of organisms came from a common ancestor?  
 In Model 3, each organism branches off of a single line, indicating that they all came from a common ancestor.
15. According to Model 3, wolves (gray and red) are more closely related to what other group—dogs or coyotes? Explain your answer.  
 According to Model 3, wolves are more closely related to dogs than coyotes. This is because both dogs and wolves branch from the same line, whereas the coyotes branch from a previous line. Therefore, dogs and wolves are more closely related and coyotes and wolves are.
16. Think about the characteristics of the organisms above.
- What are some differences that you note between wolves and dogs?
  - What similarities can you identify?

17. Modern domesticated dogs arose from wolves through selective breeding by 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?  
Human would have selected the traits that were most beneficial to us as humans. For example, less aggressive wolves would be favored over more aggressive wolves because the less aggressive wolves would be less likely to harm humans.
  - According to Model 3, what is the name of this type of selection?  
This type of selection is called artificial selection.



## Read This!

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The events that lead to changes in groups of organisms are called **selection** by evolutionary biologists. Charles Darwin (1809 – 1882) is the person credited with carefully outlining how various changes in populations of organisms might occur 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**.

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18. Is the selection that led to the development of wolves and coyotes an example of natural selection or artificial selection? Explain your choice.  
The selection that led to the development of wolves and coyotes was most likely natural selection because humans did not chose the traits that led to the speciation of coyotes from the common ancestor.
19. Refer to Model 1. Is the selection leading to changes in the *E. coli* variants natural or artificial selection? Explain your choice.  
The selection leading to changes in *E. coli* variants is natural selection because we are not choosing to kill some variants while selection for other variants. The *E. coli* is simply responding and adapting to the environment.
20. Two differences between red and gray wolves is their color and size. What environmental conditions might have resulted in selection for red wolves and gray wolves?  
Habitat is a huge environmental condition in the selection of the traits and size. The traits were best suited to the individual environments allowing those individuals the ability to survive, reproduce, and pass along their traits.



21. Refer to Model 2. Is the selection of moths that blend in to their environment an example of natural or artificial selection? Explain your choice.  
The selection that led to the moths blending into their environment was natural selection because humans did not breed the moths for that particular trait. The moths with the dark coloring were better suited to their environment so their population increased.

## Extension Questions

22. 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.

The pigweed population most likely had this variant to begin with and it allowed these individual plants to reproduce and over time, the trait spread to all the members of the population because the plants that were not resistant died and did not have the ability to reproduce.

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

The consistent use of antibacterial products will make the bacteria resistant over time. If we kill off the bacteria that are not resistant, the bacteria that are resistant will live long enough to reproduce and eventually over time, the antibacterial products will no longer work at all.