

## EVOLUTION BY NATURAL SELECTION

What are some differences you have noticed in the size and shape of dogs in your neighborhood?

They could be different size, different hair color, different shape...

Do their differences make them better at some things, but not well suited for others?

Certain traits may be more favorable for certain actions. For example some might be better at tracking scents, or chasing other animals.

What would happen if the world suddenly changed, so the only thing that dogs could eat was deer and there was absolutely no way for a dog to eat if it wasn't big or strong enough to catch and kill a deer?

Traits like speed and strength would be selected for leading to strong and fast dogs to express higher fitness. Thus the gene pool would start to shift towards faster and stronger dogs, and the small, slow and weak dogs would start to be phased out.

Next, think about the mice shown below. Using the space below, describe what is happening in figures 1-3.

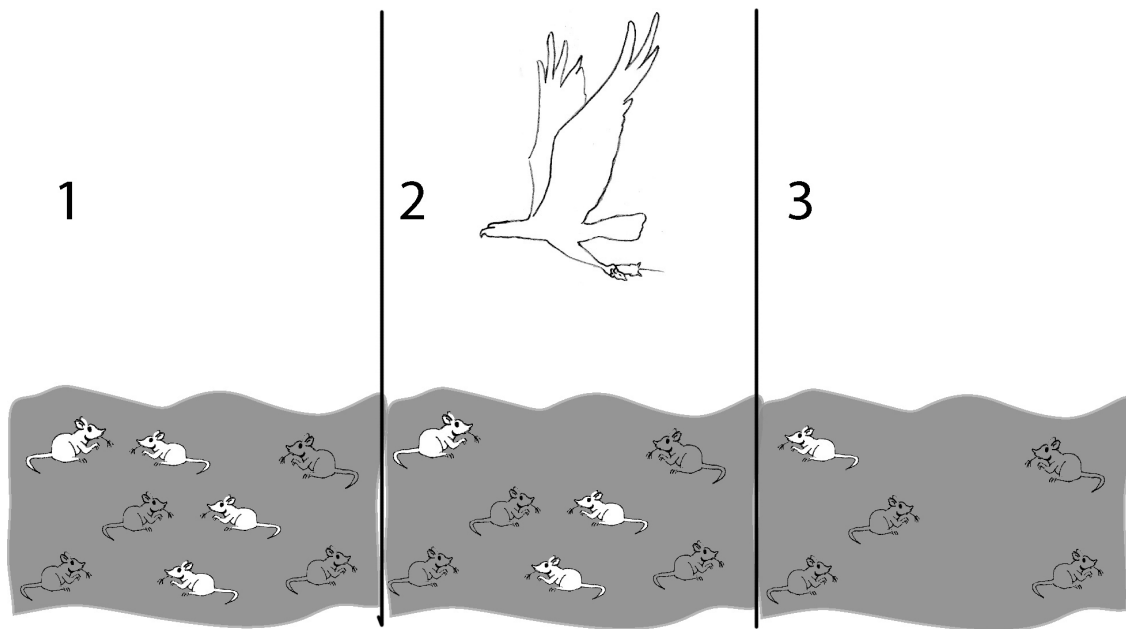


Figure one shows overproduction of mice, which also express variation. The variation shown is their hair color; some being white while others darker and blending in with the ground.

Figure two shows an environmental selection pressure in terms of the bird acting as a predator to the different mice. As one can see the white mice stick out in their surroundings and would be more likely to be eaten by the bird.

Figure three shows most of the white mice, who have the least favorable trait of being white, being removed from the population. This reduces the population, leaving less competition for the darker mice. This would lead to the darker mice expressing greater fitness than the white mice, which would result in a genetic shift towards the darker mice.

Living things that are well adapted to their environment survive and reproduce. Those that are not well adapted don't survive and reproduce. An **adaptation** is any characteristic that increases **fitness**, which is defined as the ability to survive and reproduce. What are some characteristics of animals or plants that affect their fitness?

Speed, skin color, strength, sexual appeal, intelligence...

Below are descriptions of four female mice that live in a beach area that is mostly tan sand with scattered plants. According to the definition given for fitness, which mouse would biologists consider the fittest? Explain why this mouse would be the fittest.

The mouse with the tan color fur would have the highest fitness because of its ability to survive and reproduce. It clearly has higher levels of both compared to the other mice. This more than likely because of their ability to blend in with their surroundings and hide from their predators.

Color of fur	Brown	Tan	Tan and Brown	Cream
Age at death	2 months	8 months	4 months	2 months
# pups produced by each female	0	11	3	0
Running speed	8 m/min.	6 m/min.	7 m/min.	5 m/min.

A more complete definition of fitness is the ability to survive and produce offspring who can also survive and reproduce. Below are descriptions of four male lions. According to this definition of fitness, which lion in the table below would biologists consider the "fittest"? Explain why.

Tyrone would be considered the most fit by this definition, because even though he didn't live the longest or produce the most offspring, he fathered the most cubs who reached adulthood and would be able to reproduce themselves. Thus he contributed more to the future genomes than the other lions.

Name	George	Dwayne	Spot	Tyrone
Age at death	13 years	16 years	12 years	10 years
# cubs fathered	19	25	20	20
# cubs surviving to adulthood	15	14	14	19
Size	10 feet	8.5 feet	9 feet	9 feet

(Adapted from Michigan State University, Occasional Paper No. 91, Evolution by Natural Selection: A Teaching Module by Beth Bishop and Charles Anderson, 1986)

Suppose that Tyrone had genes that he passed on to his cubs that helped his cubs to resist infections, so they were more likely to survive to adulthood. These genes would be more common in the next generation, since more of the cubs with these genes would survive to reproduce. A characteristic that is influenced by genes and passed from parents to offspring is called **heritable**.

Over many generations heritable adaptive characteristics become more common in a population. This process is called **evolution by natural selection**. Evolution by natural selection takes place over **many, many** generations.

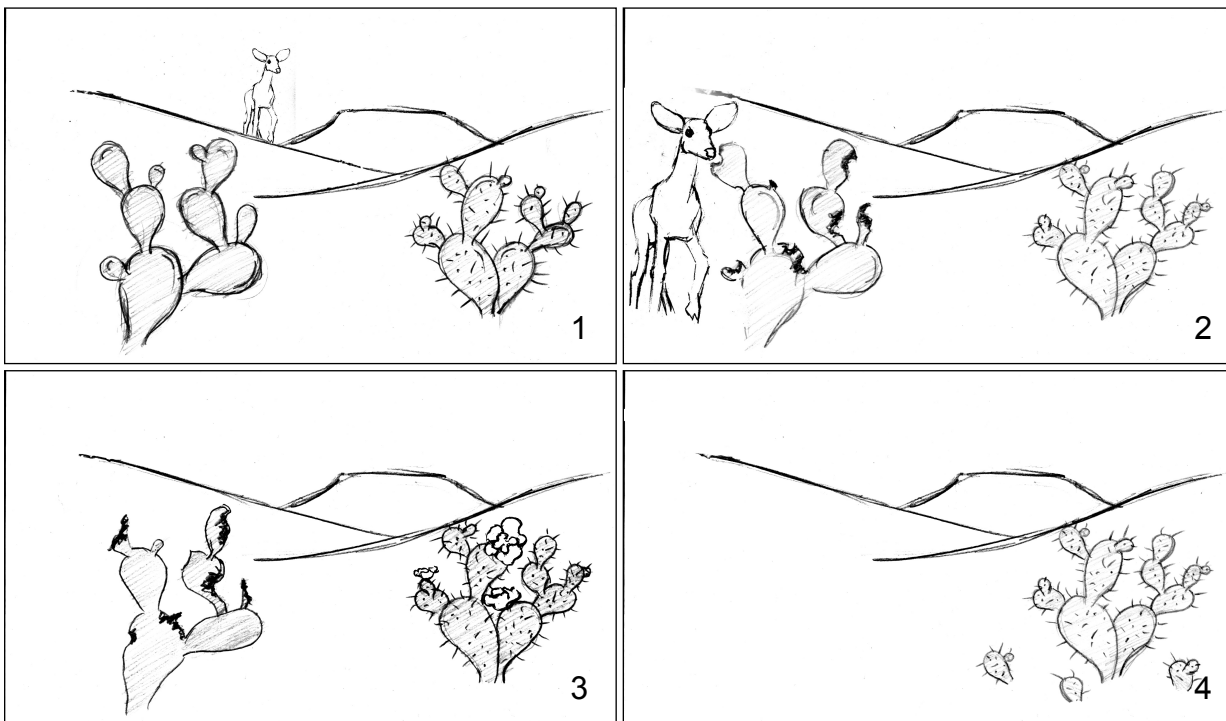
Evolution by natural selection leads to adaptation within a population. The term evolution by natural selection does not refer to individuals changing, only to changes in the frequency of adaptive characteristics in the population as a whole. For example, for the mice that lived in the beach area with tan sand, none of the mice had a change in the color of their fur; however, due to natural selection, tan fur was more common for the pups than for the mother mice.

In summary, a heritable characteristic that helps an animal or plant to have more offspring that survive to reproduce will tend to become more common in a population as a result of evolution by natural selection.

## Questions

1. Explain why a characteristic that helps an animal to live longer will generally tend to become more common in the population as a result of evolution by natural selection.  
**Since it will help the individual live longer, there is a greater chance that it will reproduce than those with lesser favorable traits. Thus the next generation will resemble the parents with the favorable trait more.**
2. Not all characteristics that contribute to longer life become more common in the population. Some characteristics contribute to long life, but not more offspring. For example, a female cat that is sterile and cannot have any offspring may live longer because she will not experience the biological stresses of repeated pregnancies. Explain why a characteristic like this which contributes to a long life, but with few or no offspring, would not become more common as a result of evolution by natural selection.  
**Since it only contributes to length of the life, and not to the ability to reproduce it will not increase fitness. And since it doesn't increase fitness it will not become more common in the population.**

Below is a series of pictures representing changes in a population of cacti over many generations.



3. Why would a deer be more likely to eat the left cactus than the right cactus?  
**The cactus on the left contains no spines which the cactus on the right does. These spines act to repel the deer from eating the cacti because it may cause pain or irritation. So the deer select the cacti with the lesser spines.**
4. In figure 3, the right cactus has flowers, but the cactus that has been eaten by the deer is too damaged to make flowers. Figure 4 shows the situation several months later. What has happened? Do you think that evolution by natural selection is occurring in this cactus population? Explain why or why not.  
**The flower is the part of a plant that allows reproduction, since the cactus on the left couldn't produce flowers because of the damage from the deer. Without the ability to reproduce, the cactus on the left ends up dying off, while the cactus on the right with greater fitness continues on. This would lead to the following generation resembling the cactus on the right more, thus showing natural selection.**
5. What adaptation seems to increase the fitness of the cacti? How do you think this adaptation increases the ability of cacti to **both** survive and reproduce?  
**The more spines present seems to increase the ability to not be eaten by the deer, which allows them to live longer and produce flowers, thus reproducing.**

6. "Survival of the fittest" is a common expression. What do you think most people mean by this expression? How would you explain this expression to help someone understand how natural selection actually functions?  
Most people probably think the stronger the individual the greater chance they have to live longer. However, it actually refers to the individual with the traits that favor higher fitness. Since fitness is defined as the ability to survive and reproduce, nature actually selects traits that will increase survival or reproduction. These traits may not always be associated with strength however.
  
7. What characteristics of humans do you think helped them survive and reproduce during the hundreds of thousands of years when they were hunter-gatherers?  
Better vision, smell, speed, strength, communication....