

Variation and Selection

If every person in your school brought their pet dog to class, you would see a lot of **variation**. There might be a tiny Chihuahua or a big Bernese mountain dog. There might be short-legged dachshunds or tall golden retrievers. There might be thin dalmatians or round-looking bulldogs. Where did they all come from? Why do they look so different?

Evidence suggests that pet dogs evolved from the wolf. Scientists think that one kind of wolf might have been comfortable around humans as far back as 135,000 years ago. These wolves were not pets, but they lived near humans. Much later, about 2,500 years ago, humans used some kinds of dogs for hunting, protecting livestock, and carrying loads. Today, there are about 400 different breeds (kinds) of pet dogs. How did 400 breeds of dog come from the wolf?

Pet dogs evolved from the wolf.

Dogs show a lot of variation.



Selective Breeding

Suppose you wanted a hunting dog to chase badgers out of their burrows. The dog would need short legs. So you would find a dog with short legs and make sure it produced offspring. You would breed the offspring with another dog with very short legs. And when those pups grew up, you would again breed the short-legged offspring. In a few **generations**, you might have a lot of short-legged dogs. Some of these dogs would be able to go into burrows to catch a badger. This might have been how the short-legged dachshund breed came to be.



A dachshund has short legs.

Selective breeding is when humans select individual organisms to breed to produce offspring with certain traits. Humans decide which qualities they want in a dog. They find individual dogs in the population that have these traits. Then they breed them to produce offspring with those same traits.

Selective breeding has produced the 400 different breeds of dogs. It has also produced many breeds of horses, cats, dairy cows, wheat, peppers, tomatoes, and corn. The desirable traits can be very different. You might want a plant that grows fast or produces fruit with no seeds. Humans are good at using selective breeding to meet their needs.



Peppers and tomatoes have many different breeds.





There is more competition for food during the winter.



Young moose (offspring) inherit traits from their parents.

Natural Selection

In nature, the environment (not humans) selects the individual organisms that will produce offspring. Some individuals are selected to reproduce, and some are not.

Life is a struggle. Animals compete for food. They also compete to find a mate. Changes in the environment, such as climate change, can place pressure on organisms. Individuals in populations that are adapted to their environment have ways to respond to these pressures.

In all populations, there is variation from one individual to the next. Some individuals will be better at getting food. Others will be better at avoiding predators. Some will be better at dealing with cold weather. These variations are important when the environment changes.

A change in the environment can add more pressure to a population. The change might be a new predator, a forest fire, or less food to eat. Some individuals in the population will be able to live successfully in this changed environment. These successful individuals will reproduce. They will leave offspring with the traits that allow them to survive in the changing environment. The traits of the survivors are passed to the next generation as **inherited traits**. That's natural selection.

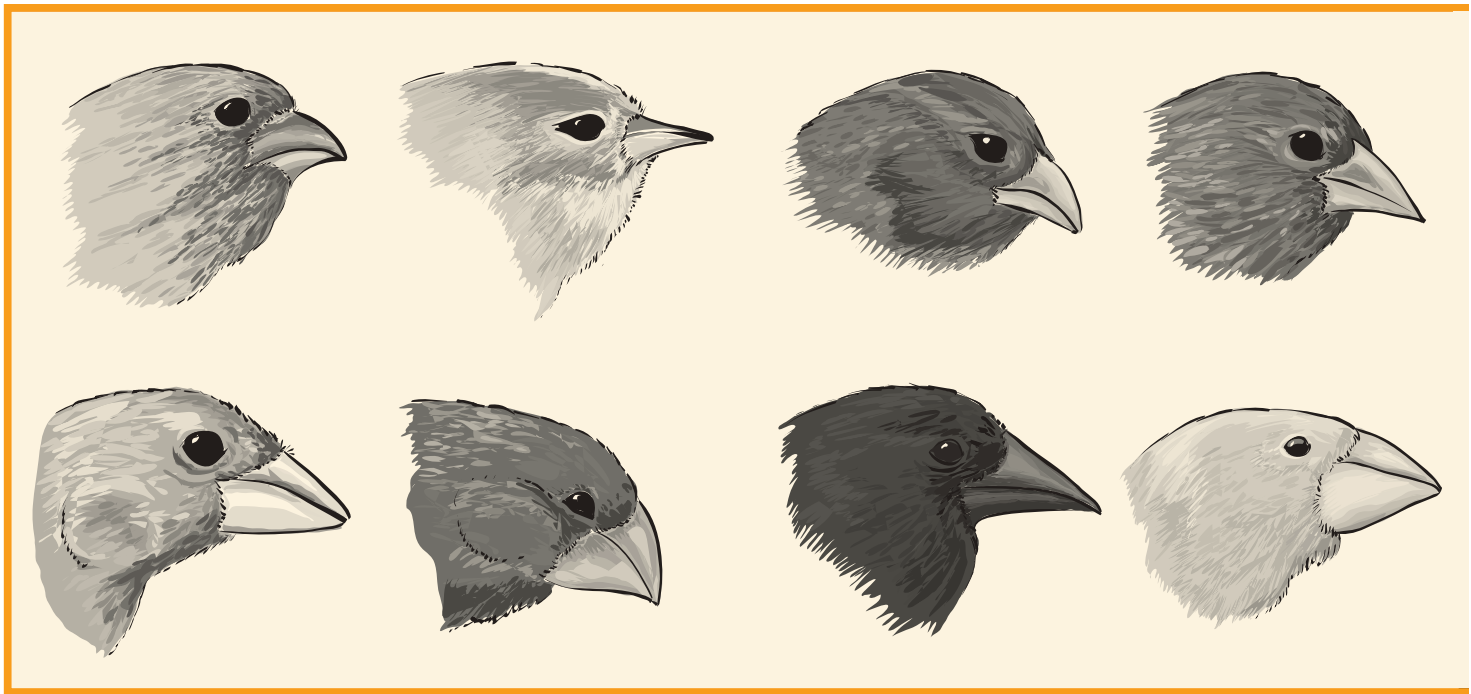
Darwin's Finches

In 1835, Charles Darwin visited the Galápagos Islands off the shore of Ecuador. He observed and described many kinds of birds with different beaks. Later, other scientists studied these same birds. These birds are known as Darwin's finches, and there are 13 of them. These finches gave scientists a new way of thinking about how changes occur in populations.

We now know that all 13 different finches on the Galápagos Islands evolved from one species of finch. That original species of finch arrived on the islands thousands of years ago. How did one species of finch evolve into 13 different species?

The Galápagos Islands





Darwin collected many finches, each with a different beak.

Scientists speculate that long ago, a big storm blew a small flock of mainland finches out to sea. The flock landed on some small, volcanic islands. The small population of finches was in a very different environment. The islands had food and places to nest, but they were not what the birds were used to.

There were seeds of several sizes from grasses, shrubs, and trees. In the population of mainland finches, there was variation in beak size. Individuals with larger, stronger beaks could crack large seeds. Individuals with smaller beaks could not. Finches with smaller beaks could more easily gather large numbers of small seeds. Individuals with large beaks could not eat the small seeds. Variations in beak size turned out to be helpful.



Medium male (left) and female (right) ground finches found on the Galápagos Islands

Finches that fed on large seeds mated and produced offspring with large, strong beaks. Their beaks allowed them to survive when large seeds were plentiful. Over time, the finches lived as separate groups because of the seeds they ate. Over many generations and many years, the large-beaked finches and the small-beaked finches were so different that they could no longer mate with each other to produce offspring. They had evolved into two new species. And the new species were different from the original mainland finches.

This same process of eating different foods based on beak size and shape produced other differences in the populations. Over time, all the differences created 13 different species. Each species has adaptations that enabled it to feed on a different food source.

What would happen to the large-beaked finches if the large seeds became scarce? They would have to find a new food source. It might be seeds of a different size or perhaps insects. Within the population of large-beaked finches would be individuals with smaller beaks. The small beaks would make it easier for those individuals to feed on a smaller food source. They would survive and reproduce. Their offspring would inherit the trait of smaller beaks. Individuals who survived would pass their traits to the next generation. The pressure of finding food would cause the population to shift to finches with smaller beaks. This would take many generations.

Darwin's Finches Today

Recently, the environment on the Galápagos Islands changed again. Fly larvae are like a **parasite** to baby finches. They burrow into a chick's body and make it sick. The finches now have to deal with this new pressure. It is not clear whether individuals in the finch populations have adaptations to protect themselves from the deadly fly larvae.

The struggle for survival goes on. Because the environment is always changing, the populations that survive and thrive are always changing. Sometimes the change in the environment is so fast or so extreme that no individuals in a population survive. Then the entire population dies or becomes extinct. Extinction is part of the process of natural selection.

A common female cactus finch



A large female ground finch opening a seed



Review Questions

1. Why don't all dogs look exactly alike?
2. In nature, what is the mechanism that selects the individuals that will breed to produce offspring in a population?
3. Describe what is meant by "a change in the environment might apply a new pressure on a population."
4. What information has come from the studies of Darwin's finches on the Galápagos Islands?
5. Look at the drawing on page 251. Compare the finches' beaks. Explain how a beak is an adaptation.