

Natural Selection

Some organisms have **favorable traits** that are well-suited to their immediate environment. Organisms with this advantage are more likely to thrive, reproduce, and pass their traits to future generations than organisms without those favorable traits. This process is known as **natural selection**.

Mutations Increase Genetic Diversity

Genetic diversity is a term that describes minor differences in the DNA of a population or species. All humans are members of the species *Homo sapiens*, and share a majority of their DNA, but no two individuals are exactly alike. That's variation! For the global population, there are many genetic variations among people, including things like eye color, hair color, and blood type. For example, apple trees are members of one species. But trees that produce Macintosh apples are different from trees that produce Granny Smith apples! This is partly because of genetic variation. New genetic variation happens because of genetic mutations, or changes to the genetic code that can be passed down to future generations.

An accidental change in the sequence of an organism's genetic material is known as a **mutation**. Mutations can occur in any cell in an organism's body. Mutations that occur during meiosis in the production of sex cells of an organism may be passed on to their offspring. Mutations lead to greater genetic diversity of the species.

Mutations may be helpful, harmful or have no effect on an organism at all. They may change an organism's appearance, body processes, or behavior.

Having a wide variety of traits in a population means that the population has a large genetic diversity. It is valuable for a population to have a large genetic diversity. When the environment changes, many individuals may die. But if there is a large genetic variety, then at least some individuals may have traits that help them survive.

A mutation can cause a new color pattern. This increases the diversity of the population.



The following are sources of genetic variation among living organisms.

- **Mutations** are a significant source of genetic variation. Mutations are responsible for introducing new traits and new versions of existing traits.
- **Sexual reproduction** results in an offspring that has a combination of genetic material from both parents, which contributes to genetic variation.

Favorable Traits

Favorable traits are traits that increase an organism's chance of survival in a particular environment. Organisms with favorable traits are more likely to reproduce and pass on their traits than organisms without favorable traits. In this way, forces in nature determine, or "select" which traits (or even which types of organisms) will continue to exist in that ecosystem. Genetic diversity makes natural selection possible. If all organisms within a population were identical, then no organisms would have a better chance of survival than another. A population with little or no diversity is less likely to survive changes in the environment.

Favorable traits may include physical traits, such as the body of a sea lion storing extra fat, or they may be instinctive behavioral traits, such as a bird building a nest to protect its young. All surviving species have adapted to different climates and conditions over the years.

If an organism dies before reproducing, then its unique traits will be eliminated from the population. On the other hand, if an organism has favorable traits that allow it to survive and produce many offspring, then its traits will be more common within the population. Over time, favorable traits are likely to increase within a population and unfavorable traits are likely to decrease.

Mutation vs. Adaptation

Genetic mutations—changes to genetic material—can be caused by a number of things. Sometimes they are caused during cell division when there is an error in the copying of genetic material. Mutations can also be caused by exposure to things like radiation, harmful chemicals (sometimes called mutagens), or viruses. In animals, when mutations occur in sex cells, they can get passed on to the next generation. When they happen to other cells, however, they cannot be transmitted to the next generation.

An **adaptation** is a change in the body structure, processes, or behavior of an organism that has evolved over a period of time through the process of natural selection. Adaptations always start out as mutations. But most mutations don't result in adaptations. In fact, the majority of mutations that occur in organisms have either no effect or a harmful effect. Adaptations, on the other hand, result from mutations that help an organism survive within its environment.

Animal Adaptation

Animals either die or adapt if their environments change. Different animals have adapted to different climates and conditions over thousands of years. That's why animals that live in cold climates have thick fur, and animals that live in warm places have bodies and behaviors that keep them cool! Animals are also adapted to finding food in certain climates, and not others. For example, a snake that lives in the desert and eats small mammals wouldn't be able to stay warm OR find food in a snowy arctic environment.

Bears have short tails because they have no need for tails. Over time, penguins have adapted so that they can survive in cold climates. Tigers have adapted so that they have strong jaws and sharp teeth and claws for catching and eating their prey. Bears have adapted with features that help them find food and stay alive. If there was an advantage to having tails—if bears could survive better with the help of tails—then they might have developed them.



Photo by D. K. Dawson

In the case of the great crested flycatcher, it has adapted in many ways to help it survive in its environment. It has good eyesight, which allows it to see and catch bugs in the air. It has bristles near its beak that allow it to sense nearby insects and quickly snap them up. The great crested flycatcher has also adapted so that it instinctively knows where to return each year to breed. This ability enables the birds to get together every year, sort of like a big convention! It ensures that they will mate with other birds and the species will survive!

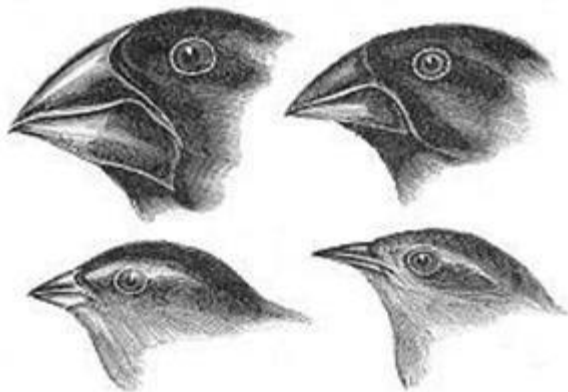
The world of animals can seem cruel to humans. But it's important to remember that when it comes to taking care of their offspring, animals have instincts which they have evolved over many generations. Animals instinctively want as many of their offspring as possible to survive into adulthood, so they can

reproduce. In order to make sure that their healthiest offspring make it to adulthood, they often ignore offspring who are weak or sick. Mother animals make sure that their strongest, healthiest babies get plenty of food, and sometimes let the weakest ones die. This may seem heartless to us, but it's part of the process that's helped the species survive for thousands or even millions of years. Adaptations are selected for by environmental pressures, so in a way, adaptations are how organisms as a group react to changing environments.

Natural Selection Can Lead to Speciation

If enough significant changes or adaptations occur in the inherited traits of a population, natural selection may result in a new species. The emergence of a new species is called **speciation**. If two groups of the same species adapt in different ways, they may become really different from each other. If the two groups become so different that they can no longer produce fertile offspring with each other, the two types are then considered different species. This is due to changes in their genetic material.

For example, there are currently thirteen different species of ground finches in the Galapagos Islands. These thirteen species can be traced to a single species from the mainland on South America. After a group of finches moved onto the Islands thousands of years ago, they had to find new food sources.



Finches of the Galapagos Islands

Luckily, the species had natural variations in the sizes and shapes of their beaks. The birds specialized in eating different food sources. Finches with short, stout, strong beaks ate primarily seeds, which had to be cracked open. Finches with long, slender beaks used them to get nectar from flowers or to reach insects in small, narrow holes. Finches with medium beaks used them to grasp and hold insects.

Over time, each variety of finch began to interact less with the other varieties. Therefore, they began to mate only with other similar finches. Eventually, each variety had gained enough genetic changes that they could no longer breed with the other varieties. This is how speciation occurs.