Key Terms: natural selection, selective pressure, fitness, artificial selection, biotechnology, and monoculture.

Natural Selection is the process by which characteristics of a population change over many generations as organisms with heritable traits survive and reproduce, passing their traits to offspring.

During natural selection, only the population of organisms changed over many generations. Individuals with variations survive specific local environmental conditions, are able to reproduce, and pass on their alleles to their offspring. This leads to a change in the population proportions (Hardy-Weinberg equation $p^2 + 2pq + q^2$).

Gene Pool – total of all alleles within a population.

Allele Frequency – is the proportion of gene copies in a population of a given allele. ($p + q = 1.00$)

Genotype Frequency – occurs for a particular pair of homologous genes, the proportion of those of a particular genotype. ($p^2 + 2pq + q^2$)

Selective Pressure

Selective Pressure is an environmental condition that select for certain characteristics of individuals and select against other characteristics.

The population characteristics can be selected for by its environment. An organism survives the change in the environment, can reproduce and pass on their genetic information.
An abiotic (non-living) environmental condition can select for or against certain characteristics in some individuals. Biotic factors; predators, parasites, and competition for resources can also select for or against certain characteristics in some individuals. Both abiotic and biotic factors are sources of selective pressures.

![Image](image_url)

Figure 7.7: The environmental pressures in this forest—a dense tree population with little sunlight reaching the floor—result in some individual organisms being more likely to survive than others. Vegetation and other organisms able to survive in low light levels will likely reproduce and pass on their beneficial alleles.

Natural Selection Is Situational

Natural selection has no will, purpose, or direction. It is unable to anticipate changes in the environment. Therefore a trait that was relevant at one time may be selected against as the environmental conditions change. Certain individuals in the population survive and reproduce, passing their alleles on to their offspring. The offspring have an advantage and pass their alleles on to their offspring. The population’s proportion changes, expressing the trait that increased the organisms chance to survive, adaptation to the environment.

*Fitness* is the relative contribution an individual makes to the next generation by producing offspring that will survive long enough to reproduce.
A high degree of fitness means that an organism will survive and reproduce, thereby passing on its advantageous genes to its offspring and the offspring live long enough to reproduce. Fitness also is described as the number of reproductively viable offspring that an organism produces in the next generation.

**Learning Check: questions 7 – 12, pg. 307**

**Artificial Selection**

Selective breeding is a form of Artificial selection. Selective breeding and artificial selection are also different forms of biotechnology. Humans use biotechnology to produce useful products.

Most of the food we eat, grains, fruits, vegetables, meat and milk, come from species that have been selectively bred.

*Artificial selection* is selective pressure exerted by humans on populations in order to improve or modify particular desirable traits.

- cats bred for appearance
- cows bred to increase muscle for meat consumption
- chickens bred to produce more eggs
**Biotechnology** is the use of technology and organisms to produce useful products.

Figure 7.9: These six agricultural plants look very different from each other, but they carry much of the same genetic material as the wild mustard plant. The genetic differences between them affect the formation of flowers, buds, stems, and leaves.

The key difference between natural selection and artificial selection is that in natural selection the environment plays a role, and in artificial selection humans play the role of the environment.

Figure 7.10: This graph shows the results of selective breeding for oil content in plants. In this example, corn plants were selected for breeding based on high or low oil content of the kernels.
Consequences of Artificial Selection

Artificial selection has positive and negative consequences. Some artificial selection techniques, such as; genetic engineering, introduces new genetic information into domestic organisms. The purpose is to create domestication of organisms, similar. To make organisms similar, genetic diversity must be reduced. Organisms are selectively bred to produce qualities that breeders want, similar, expressing less diversity.

Risk is created, when organisms are genetically similar there is a greater chance that new diseases may infect the organisms, and the whole population may be wiped out.

Monoculture is extensive plating of the same varieties of a species over large expanses of land.

Figure 7.12: This monoculture shows the vast expanse that is covered by one crop (wheat), made up of plants that are artificially selected to be similar.

Gene Banks

To protect against disasters created by a lack of diversity gene banks are maintained. Gene banks contain information from early species of organisms, ancestors to the modern organism. By preserving these organisms, their genetic diversity is available for introduction into modern plants if a need arises.
From Diversity to a Theory of Evolution

Adaptation results in evolution over a long period of time. The theory of evolution by natural selection was developed and supported by fossil evidence that expresses these adaptations.

Review Questions: questions 1 – 14, pg. 311

Activity 7.3: Modeling Natural Selection 1 – 4, pg. 302

Activity 7.4: Selective Breeding 1 – 3, pg. 309

Study Guide: Natural Selection (7.2) 1 – 5, SG. 110 – 111

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Practice Test: questions, 1 – 14, SG. 116 – 117