

Biology Notes

Topic: Selection

Objectives:

At the end of this topic, the students should be able to:

- 1. Define and explain the term selection.*
- 2. Name and differentiate between the two types of selection.*
- 3. Outline the role of artificial selection in crop and livestock production.*
- 4. Relate selection to variation.*
- 5. Describe the relationship between competition and selection.*
- 6. Describe natural selection as a possible mechanism for evolution.*
- 7. Describe antibiotic resistance as an example of natural selection.*

Selection

In any population of animals or plants there is usually fierce competition for food and an ever-present threat of being attacked by enemies (prey-predator relationship). This creates a struggle for survival in which every individual is fighting desperately for survival.

Now within a species there is considerable **variation** between individuals and some individuals are better adapted to the environment than others. e.g. some may be particularly strong, or good at running which make them more likely to survive. These individuals are most likely to reproduce, and hand on their good qualities to their offspring.

Selection is the choosing of organisms with favourable characteristics for survival. This may be done naturally – natural selection or artificially – artificial selection.

Natural selection is the process in which nature selects the fittest individuals and rejects the weaker ones.

Artificial selection, on the other hand, is the process in which a person (Man) can select animals or plants with good qualities and allow them to breed, whereas those with poor qualities can be prevented from breeding. By careful cross-breeding, one can bring together the good features of two different varieties and combine them in the offspring.

The role of artificial selection in crop and animal production

Over the centuries, Man has succeeded in interfering with the process of natural selection in order to produce animals and plants suitable for his own agricultural purposes. He has taken animals which would not necessarily have competed successfully in the wild, but which had phenotypic characteristics that were useful to him and has bred them over many generations. At each generation, he has selected for breeding those animals that possess these qualities to the greatest degree, with the result that the domestic animals have, in many cases, become quite unlike their wild ancestors.

All of our familiar breeds of farm animals, and domestic animals such as cats and dogs, have been produced in this way. So have various varieties of garden plants, such as roses. By the same process, plant breeders have produced new varieties of crop plants, which are better than the older ones. e.g. we now have varieties of wheat and rice, which grow more quickly, give a higher yield of grain and are more resistant to disease. Species produced by this method are usually of higher economic value than their predecessors.

Here is a list of some beneficial characteristics that may be artificially selected for propagation:

1. early maturity
2. resistance to disease
3. increased length of productive seasons
4. adaptation to local or unfavourable conditions
5. greater efficiency of conversion of plant to animal tissues in animals bred for meat
6. higher yields e.g. in terms of milk, eggs, wool, fruits etc.
7. ease of harvesting e.g. dwarf varieties coconut palms

Selection and variation.

Selection will only occur if individuals of a species differ from one another. In other words they must show **variation**. Moreover, the variation must be **genetic** so that beneficial characteristics can be passed from parents to offspring. Mutation provides the best kind of variation for natural selection.

Competition and selection

All organisms in a population must compete for food, light and living space. There must therefore be extreme competition between organisms. Only those organisms that are well adapted to their environment will survive, whilst those less well adapted will perish. The well adapted will hand on their characteristics to their offspring while those less well adapted will disappear from the population.

Natural selection and evolution

Evolution, in the true sense of the word means, **gradual changes over time**. Indeed, in the fossil record, there is great deal of evidence to show that animals and plants have undergone gradual changes since creation. **The discrepancy with the theory of evolution is in the origin of life – as Christians we do not subscribe to the big bang theory nor to the evolution of Man from some primitive organism.** The theory of evolution suggests that the best-adapted organism will be selected by nature to survive and hand on their characteristics to their offspring. Thus the species as a whole will gradually change as it becomes more successful in its battle to survive against enemies and its environment.

Example of natural selection

The development of strains of antibiotic resistant bacteria is an example of natural selection. Some antibiotics kill bacteria outright while others inhibit their growth. Occasionally bacteria become resistant to such actions. In the case of the antibiotic, penicillin, the bacteria produces an enzyme called penicillinase, which destroys penicillin.

These bacteria can then reproduce and pass on their penicillin – resistant capability to their offspring. Nature would therefore select that species of bacteria for survival.

The factors that may give rise to resistant forms of bacteria are:

- antibiotics prescribed in inadequate doses and/or
- antibiotics prescribed but not used completely

To overcome this, doctors have to resort to other drugs some of which may have dangerous side effects.

Questions

1. (a) Explain the difference between natural selection and artificial selection, giving an example in each case. (4)
 - (b) (i) The ‘struggle for existence’ arise largely from competition. Explain with an example why competition should create a ‘struggle for existence’. (2)
 - (ii) Suggest one other process in biology, apart from competition, which may contribute to the struggle for existence’. (1)
 - (c) Mutation provides the best kind of variation for natural selection.
 - (i) Explain why. (2)
 - (ii) What does ‘best’ mean in this context? (1)
2. The wildebeest were migrating across the great plains of the Serengeti: thousands of them – some large, some small, some strong, some weak. Lions followed them, intent on catching the slowest ones. Water was scarce and only the most persistent wildebeest could take advantage of the occasional water holes.
 - (a) Which phrases in the passage illustrate
 - (i) variation
 - (ii) competition
 - (iii) survival of the fittest (3)
 - (b) Explain how the passage illustrates the theory of evolution. (4)
 - (c) Explain how natural selection has been involved in the fact that there are some bacteria that were once killed by penicillin but are now resistant to it. (3)