

LESSON 8 What Is Evolution By Natural Selection? =====

Objectives

When students have completed this lesson, they will be able to:

- state the parts of the theory of natural selection;
- describe the role of gene mutation in natural selection;
- explain how natural selection might have produced a modern form of an animal (the giraffe).

Exploring Science / Historical Steps

A common mistake in the explanation of natural selection is to say that the animal acquired a new characteristic during its lifetime, which was then inherited by its offspring. This is the Lamarckian theory of evolution, and is contrary to Darwin's theory. Applied to the English peppered moths, the Lamarckian theory would state that the soot triggered some moths to turn dark, and the next generation of these moths inherited this dark color.

For middle schoolers it may be best to simply point out that Lamarck's proposed means of evolution has long been thought to be wrong. However, it must be noted (and perhaps shared outside of class with highly motivated students) that the concept of **epigenetics** - which came to the forefront at the turn of the century - reveals that there appear, in fact, to be some mechanisms whereby environmental changes actually do alter genes! More specifically, there is growing evidence that the *switching* on or off of some genes is influenced by the environment. In some cases, the genes that are turned on by an event in the environment do get passed on to the next generation! This is more likely to occur when the environmental change is extreme. An interesting account of evolution via epigenetics is Peter Ward's book Lamarck's Revenge.

Another means of causing change in a species is for the genes of one individual to be literally added to the genes of another. Most famously, it is now widely accepted that eukaryotic cells' mitochondria and chloroplasts are the descendants of small bacteria that somehow survived within a larger predatory bacteria; the "eaten" bacteria became vital structures of the eukaryotic cell. This topic, endosymbiosis, is introduced to students in this unit's final lesson.

Excluding epigenetic influences and the "adoption" of genes from another organism, the explanation (to the majority of students) of the peppered moth story, and of natural selection in general, can follow the following pattern:

First, not all offspring of two parents are identical; there is some variation. Some offspring will be better fit in their particular environment - and therefore will be more likely to survive, and to later reproduce and pass along their better adapted structure.

Second, for reasons not fully understood, changes, called mutations, sometimes occur in genes. If these changes are adaptive, as was the dark color of moths, those offspring who receive these genes will more likely survive and reproduce. In this example, genes for light color are nonadaptive. As further demonstration of the principle of natural selection, it is instructive to note that since about 1970, when laws were passed in England requiring factories to install anti-soot devices, the ratio of light-colored peppered moths to dark ones has become close to what it was before the advent of the factories.

For the inference question, students should answer that a white hare in the snow has a better chance of survival than a brown hare. White hares match the color of their background, so they more easily elude predators. You may want to tell students that the same hares that are white in winter often turn brown in the summer. This adaptive coloration helps them to survive for the same reason.

Natural Selection

Have students go through the five steps of the theory of natural selection as it applies to the giraffes in the illustration. (1) More baby giraffes are born than the environment can support. (2) The young giraffes compete for food. (3) The giraffes that have been born with relatively long necks are able to reach the leaves that are higher in the trees. (4) The best adapted young giraffes - those with the longest necks - survive, while the others die while still young. (5) The long-necked giraffes live long enough to reproduce, passing along to succeeding generations the genes for long necks. The genes for short necks "died" with the animals that had short necks..

To Do Yourself

If several groups in the class carry out the activity, you may have them use different kinds of seeds for comparison. Or, you might have all students use the same kind of seeds; this will produce greater numbers, and therefore greater reliability, in the results.

Questions

Please see below.

Review

Please note: I have not made the answers available online, in the small chance that a student might discover them. Of course, the answers to these questions will be included in the version of the Teacher's Guide provided to teachers who purchase the text.