

TwoOldGuys™ Study Guides

BI114 Biological Concepts for Teachers

Chapter 3. Inheritance and Evolution

3.4. Evolution, micro-evolution

Based on Indiana's Academic Standards, Science, as adopted by the Indiana State Board of Education, Nov 2000.

Numbers refer to the age-appropriate grade-level for the content.

Review

After we reviewed the diversity of living things, we looked at the patterns of inheritance. We established that information describing the appearance [and function] of each species is transmitted from one generation to the next, with each individual receiving one allele from each parent. In this manner, the species is able to persist over many generations while maintaining the characteristics of the species. We also established that this information is sometimes altered, and that the altered alleles are transmitted by the same rules. Thus the changes in traits are still inherited.

We also provided a mechanism for the environment to 'select' which traits to keep in the species and which to remove. This process is called natural selection, and works by increasing reproduction in favored traits, and by decreasing survival in unfavored traits.

Micro-Evolution

grades secondary: to college:

Population changes to remain adapted to changing environment

When the environment at any local site changes, the traits that were favored in a population may no longer be the favored traits, but some other traits may be selected. Either the newly selected traits will confer an increased survival or an increased reproduction, either of which can be expected to lead to a change in the traits in the population over generations of the species of the population. There are three possibilities for the nature of the environmental change at the site: the change may be directional, cyclic or random.

Under a regime of directional change, the environmental factor will continue to change in the same direction. For example, if global warming is occurring [and it is] then the average temperature will continue to become warmer. Considering that there was a glacier covering North America as far south as Pennsylvania, Ohio, Indiana, Illinois, Iowa, and Kansas, as recently as 23,000 yrs BP and now the continental glaciers are restricted to Greenland, it is not possible to conclude that global warming is not occurring. Under a continually changing environment, natural selection should drive population change toward those individuals better adapted to the new environment. This population change will continue as long as genetics allows. When the genetics (available alleles for adapted traits) no longer allows additional change, the species will become locally extinct, and will be replaced by a different species which is better adapted to the environment.

Under a regime of cyclic change, the environment will first change in one direction then reverse direction. Over recorded weather in the United States (roughly 1850 to the present), there has been a consistent 11 year cycle between wet years and dry years. In Peoria, Illinois, the annual precipitation cycles between about 31 inches in the dry cycle to almost 36 inches in the wet cycle. Under such a regime, the population will spend half of the cycle [about 5 years adapting to drier conditions, then spend the next half of the cycle adapting to wetter conditions. This

can be expected to maintain a diverse population, with genetic information for both favored traits.

When the environmental change is random, natural selection is not effective because the changed conditions will not remain long enough to cover multiple generations of the population. Again, the population should remain diverse to anticipate possible future variations in the environment.

In order for these Darwinian mechanisms to affect the traits of any population, the conditions must persist across several generations before the population can change. This level of stability (or resistance to change) is believed to exist to assure that the species will not attempt to evolve permanently to a temporary change in the environment.

Species remains same

An important aspect of micro-evolution is that the expression of the traits in the population change, but the species remains the same species.

When I was in grade school, we would collect long-stem dandelions as bouquets for our teachers. Today, in suburban areas, dandelions have short stems. The older long-stem dandelions had blossoms on stems that were 10 – 12 inches long. The contemporary short-stem dandelions have blossoms on stem 1- 3 inches long, with some growing a longer stem after the seeds form. The traditional long-stem dandelion held the blossoms high above the surrounding grasses, so the wind could distribute the seeds to the neighbor's yard. These long-stem dandelions were very difficult to mow with the old-time reel type push mower. The frame of the reel merely pushed the dandelion blossoms aside, and they were not cut off. When some clever person took the fan from the ceiling of the local barbershop, added wheels and a gasoline engine, the long-stem dandelions were cut off. However the short-stem dandelions were

below the rotary blade, escaping being cut off. In addition the rotary blade was a fan that created an upward wind, lifting the seeds up and out the discharge chute where the wind could transport the seeds to the neighbor's yard. The description of a dandelion changed from long-stem to short-stem, because of the change in environment (type of lawn mower), but the short-stem plants are still dandelions. There are still long-stem dandelions in weedlots and in agricultural fields.

There are numerous other, and better documented, examples of micro-evolution occurring. Remembering that each time a hypothesis is confirmed, we become more confident that the hypothesis represents reality well, this gives us considerable confidence in the hypothesis of micro-evolution. All biologists [whose opinions about micro-evolution are known to me] agree that micro-evolution should be accepted as a valid theory.