# Introduction to Ecology and Evolution

## Definitions

### *Ecology*

The word **ecology** first came into use in 1869 by Ernest Haeckel
Haeckel based ecology on the Greek word *oikos,* meaning home or house
Literally, ecology means the "study of the household"
In effect, then, ecology could be considered as the **study of the economics of nature**

Today most textbooks define **ecology** as the study of the relationships of organisms to their environment and to one another

### *Evolution*

**Evolution** can be defined as the change that occurs in the characteristics of living things through time (or change in the form and behavior of organisms between generations)
The forms of organisms at all levels - from DNA sequences to morphology and social behavior - can be modified from those of their ancestors during evolution

Evolution, in its broadest sense, is genetic change in a population of organisms over time

## The Interaction of Ecology and Evolution

Ecology and evolution are intimately related because and organism's ecological situation directs its evolution, and the organism's response to its ecological situation may be evolutionary

Let me provide you with an *example* to bolster this statement
A species of desert plant faces a rather harsh climate that include high temperatures and very little precipitation
As a consequence, it must compete for water with neighboring plants
This ecological situation tends to favor those plants that produce a mat of fine roots near the soil surface; this type of root system would more effectively capture the water that occasionally falls in the area
All else being equal, the shallow rooted plants would be expected to grow more vigorously than more deep-rooted plants; they my exhibit higher population densities and out-compete neighboring plants for scarce water
Ecological relationships have, thus, been fundamentally changed, and many other species in the desert may be directly or indirectly affected by these changes

In a general sense, ecological situations can be viewed as forces leading to evolutionary solutions to ecological problems
Some of these evolutionary solutions can be viewed as **adaptations,** a genetically determined feature that has become or is becoming prevalent in a population because it improves an organism's ability to survive and reproduce in a particular environment

**Proximate and Ultimate Explanations**

Scientists often distinguish between two kinds of explanations for ecological phenomena and these can be discussed to further accentuate the interaction between ecology and evolution: proximate explanations and ultimate explanations

**Proximate explanations** offer immediate causes for a particular phenomenon
**Ultimate explanations** provide historical reasons for observed ecological phenomena

The difference between them is in their outlook: between thinking over a more recent time scale (the time scale over which individuals live and die) versus an historical time scale (geological time)

**Ecology, Evolution and the Nature of Science**

One of the goals of this course is to provide you with an understanding of the empirical basis of our ecological and evolutionary knowledge
Thus, it is important to be familiar with the concepts involved in conducting scientific research

**Science is a fallible** enterprise: 1) scientists, being human beings, will make mistakes and 2) science always only gives us **tentative results**.
Science is a discipline that yields an understanding of reality given all available evidence.

One great value of science is that it provides us with **methods** by which we can arrive at justified beliefs
It is perhaps better to speak of scientific theories as being confirmed or disconfirmed, and these may each be to a greater or lesser degree.

The nature of confirmation: one important way in which theories are confirmed is by making successful **predictions**.

In the end, what undermines a theory is not a false prediction, but a better successor theory (i.e., one that does a better job of explaining the facts).

Predictions, however, are not the sole test of a theory.
Indeed, perhaps the most important test is the **explanatory scope** of a theory.
Science is an active enterprise seeking to unite facts by explaining how the world is such that these facts might be expected.

It is important to recognize that doing good science does not necessarily require that we make direct observations of the natural world.
Hypotheses can be invalidated, or conversely it can gain credibility and stature, based on **inference** rather than observation.

With this general overview of the nature of science in mind, we can now begin to consider the evidence that is used to support our ecological and evolutionary theories.