

What is ecology?

# Origin of word

*oikos* = the family household

*logy* = the study of

# Interesting parallel to *economy* = management of the household

Many principles in common

- Resource allocation
- Cost-benefit ratios

## DEFINITIONS:

Haeckel (**German zoologist**) 1870: “By ecology we mean the body of knowledge concerning the economy of Nature - the investigation of the total relations of the animal to its inorganic and organic environment.”

Sir John Scot Burdon-Sanderson (**English physiologist**) 1890s: Elevated Ecology to one of the three natural divisions of Biology: Physiology - Morphology – Ecology

H. G. Andrewartha (**the most influential Australian ecologist of the twentieth century**) 1961 : “The scientific study of the distribution and abundance of organisms.”

Odum (1963): “The structure and function of Nature.”

**Definition we will use (Krebs 1972):**

***“Ecology is the scientific study of the processes regulating the distribution and abundance of organisms and the interactions among them, and the study of how these organisms in turn mediate the transport and transformation of energy and matter in the biosphere (i.e., the study of the design of ecosystem structure and function).”***

**The goal of ecology is to understand the principles of operation of natural systems and to predict their responses to change.**

## **What ecology is not**

Ecology is not environmentalism, nor “deep ecology.” Ecology is science, based on biological, physical and chemical principles, and should be value-free. Environmentalism advocates for certain actions and policy positions.

## II. Why study ecology?

**Curiosity** – How does the world around us work? How are we shaped by our surroundings?

**Responsibility** – How do our actions change our environment? How do we minimize the detrimental effects of our actions? Overfishing, habitat destruction, loss of biodiversity, climate change.

## Why study ecology? (continued)

**Nature as a guide** – The living world has been around much longer than we have and has solved many problems with creative solutions. Ecological systems are models for sustainability. How can we feed our growing population? Where will we live?

**Sustainability** – a property of human society in which ecosystems (including humans) are managed such that the conditions supporting present day life on earth can continue. Ecology helps us understand complex problems. Examples: Cane toads in Australia, Feral pigs in Hawai'i, Nile Perch in Lake Victoria, Wolves in Yellowstone

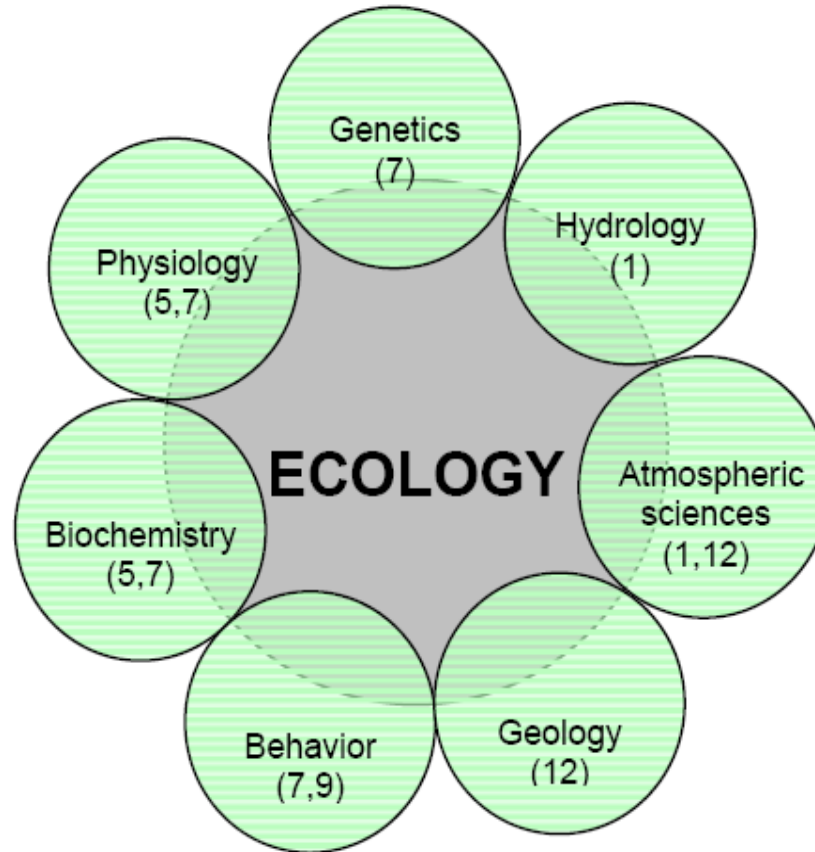
**III. How to study ecology?** What kinds of experiments do ecologists perform?

**Observations** – Go into the field and see what's happening

**Microcosms** – Isolate a portion, limit factors, manipulate conditions.

**Mathematical models** – Describe ecosystems interactions as equations.

**Connections to other disciplines :**



adapted from *Elements of Ecology*, R.L. Smith and T.M. Smith, 4<sup>th</sup> Ed.

#### IV. Where to study ecology?

Organism ← (Tissues) ← Organelle ← Molecule ← Atom



**Population:** Group of interacting and interbreeding organisms.



**Community:** Different populations living together and interacting.



Populations can interact as competitors, predator and prey, or symbiotically.

**Ecosystem:** Organisms and their physical and chemical environments together in a particular area.



“The smallest units that can sustain life in isolation from all but atmospheric surroundings.”

**Biome:** Large scale areas of similar vegetation and climatic characteristics.



**Biosphere:** Thin film on the surface of the Earth in which all life exists, the union of all of the ecosystems. This is a highly ordered system, held together by the energy of the sun.

Populations are shaped by their **abiotic** surroundings, and, in turn, change their **abiotic** surroundings. For example, O<sub>2</sub> in atmosphere from photosynthesis. Others?

These levels of organization do not exist in isolation. There are feedbacks between the largest and smallest **scales**.

**Interactions among different levels lead to emergent properties.**

Principle of hierarchical control (Odum): “As components combine to produce larger functional wholes in hierarchical series, new properties emerge. That is, one cannot explain all the properties at one level from an understanding of the components at the one below.”

## V. How will we learn about ecology?

Start with **energy** flows

At the individual level, how do organisms “make a living”?

At the ecosystem level, how does energy move around?

Move on to **nutrients**

How does nutrient availability limit organism growth?

On an ecosystem and global scale, how do organisms fit in to global nutrient cycles?

Then focus on **populations** and **communities**

Numerical models of the growth of individual populations

Then apply these to model competition between populations for the same resources

Metrics of species diversity and responses of communities to changes