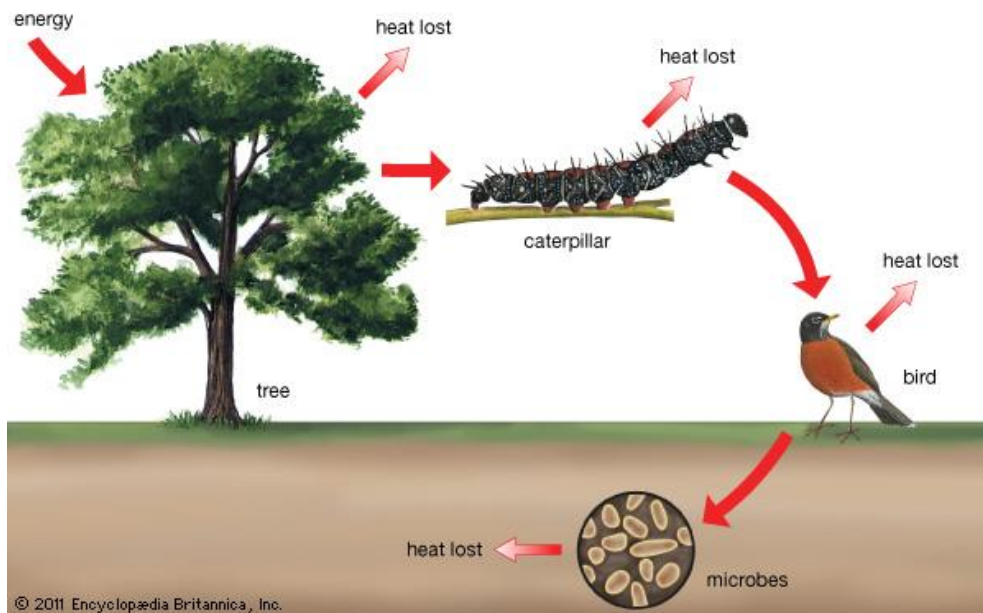


**Energy transfer and heat loss along a food chain**



# TOPIC NOTES FOR BIOL2711: ECOLOGY

Completed in 2017 with Distinction

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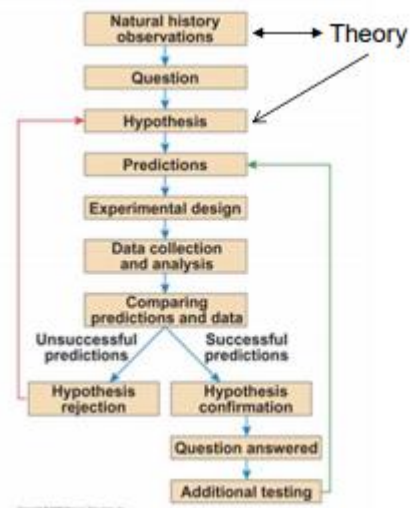
## WK2: What is ecology? – (Dr. Guido Parra)

The first definition of ecology was in 1866 by Ernst Haeckel, "the comprehensive science of the relationship of the organism to the environment".

Townsend et al. (2008) defined it as "the scientific study of the distribution and abundance of organism, the interactions that determine distribution and abundance and the relationships between organisms and the transformation and flux of energy and matter".

- Abiotic factors: non-living components of the environment that include light, water, wind, nutrients, heat, etc.
- Biotic factors: living organisms of an environment including plants, animals, microorganisms, humans, etc.
- Environmental science: examines the effects of humans on the environment of the earth including its physical, chemical and biological makeup.
- Environmentalism: is a cause or social movements with an important agenda for political and social change intended to minimize human impact on the Earth. This can be with or without scientific backing.
- Conservation biology: is the integration of environmental science and environmentalism and others, focusing on how to protect and restore biodiversity using science to support social and political causes.

- Descriptive
  - Mainly natural history (observations) e.g. habitat location, population size, interactions
  - Foundation of all ecological science
- Functional
  - Focuses on the roles/functions that organisms play in the community or ecosystem where they are present
  - Studies proximate causes: the dynamic responses of populations and communities to immediate factors of the environment i.e. predators effect upon prey populations
- Evolutionary
  - Considers organisms and relationships between organisms as historical products of evolution
  - Studies ultimate causes: the historical reasons why natural selection as favoured particular adaptations.



- Species: this refers to a genetically distinct individual as part of species that lives within a particular area.
- Populations: groups of individual's belonging to the same species.
- Communities: all of the populations of different species within a shared environment
- Ecosystems: the abiotic and biotic factors as well as their interactions within a shared environment
- Biomes: a large naturally occurring community of flora and fauna occupying a major habitat identified by the presence of particular climate, vegetation and fauna.
- Biosphere: the global ecological system that integrates all living organisms and their interactions including with abiotic factors.

Ecology relies on scientific evidence and the application of statistics. Statistical analysis is essential as it provides evidence and a level of confidence in the accuracy of the conclusion. This is traditionally tested by using null-hypotheses.

- $H_0$ : representing no difference between population parameters of interest
- $H_a$ : representing either a unidirectional or bidirectional alternative
- Test statistic is computed from sample data, and significance is determined according to probability level.

Mathematical models are useful for exploring scenarios and situations for which real data is either non-existent or unobtainable.

## WK2: Ecology's evolutionary backdrop – (Dr. Guido Parra)

The earth is inhabited by a diverse variety of species with estimates of 8.7 million different species on earth. This explicit diversity was explained by Charles Darwin and Alfred Wallace whom developed the theory of evolution by natural selection which works under some basic principles:

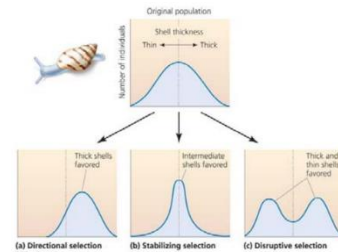
- Individuals that form a population of a species are not identical
- Some of the variation between individuals is heritable, that is, it has a genetic basis and is therefore capable of being passed down to descendants.
- All populations could grow at a rate that would overwhelm the environment, but in fact, most individuals die before reproducing and most (usually all) reproduce at less than their maximal rate
- Different ancestors leave different numbers of descendants and they therefore do not all contribute equally to subsequent generations.

**Evolution:** the change overtime of the prevalence of different heritable traits within a population or species.

Individuals that were best able to survive had a higher capacity to reproduce. This idea is described by Herbert Spencer as 'the survival of the fittest' whereby fitness is used to describe biological success.

Natural selection can occur to phenotypes which are observable attributes of individuals e.g. colour, size, shape. This selection can be:

- Directional selection: where one extreme phenotype is favoured
- Stabilizing selection: whereby intermediate phenotypes are favoured
- Disruptive selection: where extreme phenotypes are favoured as opposed to the intermediate phenotypes.



**Coevolution:** the process in which two species evolve in response to changes in each other over a period of time. Examples include plants and their pollinators, predator on prey, parasite on host and competitive neighbour on neighbour.

Diffuse coevolution: refers to a form of coevolution whereby it is more than just two species involved.

Natural selection can also lead to the creation of new species if it is coupled with reproductive isolation.

- Allopatric speciation: this is the most obvious example of speciation and occurs when a population is divided by a physical barrier e.g. glaciers, rivers or mountains. The divided populations can undergo different directions of natural selection resulting in reproductive isolation.
- Sympatric speciation: this occurs when a new species forms from an existing population that has become reproductively isolated within the same area. This generally occurs due to behavioural differences such as different feeding strategies or mating in different seasons.

Climate has had a substantial effect on the present distributions of plants and animals with changes in temperature having a direct impact on species diversity and the size of different ecosystems. Continental drift also influences the distribution of closely related group and explains ancestral distribution across multiple and now separated continents.