**Theoretical Biology**

**First semester: By Dr. Ghassan Hamdan Jameel**

INTRODUCTION…

**Biology** is a [natural science](http://en.wikipedia.org/wiki/Natural_science) concerned with the study of [life](http://en.wikipedia.org/wiki/Life) and [living organisms](http://en.wikipedia.org/wiki/Organism), including their structure, function, growth, [evolution](http://en.wikipedia.org/wiki/Evolution), distribution, and [taxonomy](http://en.wikipedia.org/wiki/Taxonomy_(biology)).  In general, biology recognizes the [cell](http://en.wikipedia.org/wiki/Cell_(biology)) as the basic unit of life, [genes](http://en.wikipedia.org/wiki/Genes) as the basic unit of [heredity](http://en.wikipedia.org/wiki/Heredity), and [evolution](http://en.wikipedia.org/wiki/Evolution) as the engine that propels the synthesis and creation of new [species](http://en.wikipedia.org/wiki/Species). It is also understood today that all organisms survive by consuming and transforming [energy](http://en.wikipedia.org/wiki/Energy) and by [regulating](http://en.wikipedia.org/wiki/Homeostasis) their internal environment to maintain a stable and vital condition.

The origins of modern biology and its approach to the study of nature are most often traced back to [ancient Greece](http://en.wikipedia.org/wiki/Ancient_Greece). While the formal study of [medicine](http://en.wikipedia.org/wiki/Medicine) dates back to [Hippocrates](http://en.wikipedia.org/wiki/Hippocrates) (ca. 460 BC – ca. 370 BC), it was [Aristotle](http://en.wikipedia.org/wiki/Aristotle) (384 BC – 322 BC) who contributed most extensively to the development of biology.

Biology began to quickly develop and grow with [Anton van Leeuwenhoek](http://en.wikipedia.org/wiki/Anton_van_Leeuwenhoek)'s dramatic improvement of the [microscope](http://en.wikipedia.org/wiki/Microscope). It was then that scholars discovered [spermatozoa](http://en.wikipedia.org/wiki/Spermatozoa), [bacteria](http://en.wikipedia.org/wiki/Bacteria), [infusoria](http://en.wikipedia.org/wiki/Infusoria) and the diversity of microscopic life. Investigations by [Jan Swammerdam](http://en.wikipedia.org/wiki/Jan_Swammerdam) led to new interest in [entomology](http://en.wikipedia.org/wiki/Entomology) and helped to develop the basic techniques of microscopic [dissection](http://en.wikipedia.org/wiki/Dissection) and [staining](http://en.wikipedia.org/wiki/Staining).

In the early 19th century, a number of biologists pointed to the central importance of the [cell](http://en.wikipedia.org/wiki/Cell_(biology)). Then, in 1838, [Schleiden](http://en.wikipedia.org/wiki/Matthias_Jakob_Schleiden" \o "Matthias Jakob Schleiden) and [Schwann](http://en.wikipedia.org/wiki/Theodor_Schwann) began promoting the now universal ideas that (1) the basic unit of organisms is the cell and (2) that individual cells have all the characteristics of [life](http://en.wikipedia.org/wiki/Life), although they opposed the idea that (3) all cells come from the division of other cells. Thanks to the work of [Robert Remak](http://en.wikipedia.org/wiki/Robert_Remak) and [Rudolf Virchow](http://en.wikipedia.org/wiki/Rudolf_Virchow), however, by the 1860s most biologists accepted all three tenets of what came to be known as [cell theory](http://en.wikipedia.org/wiki/Cell_theory).

Meanwhile, taxonomy and classification became the focus of natural historians. [Carl Linnaeus](http://en.wikipedia.org/wiki/Carl_Linnaeus) published a basic [taxonomy](http://en.wikipedia.org/wiki/Taxonomy_(biology)) for the natural world in 1735 (variations of which have been in use ever since), and in the 1750s introduced [scientific names](http://en.wikipedia.org/wiki/Binomial_nomenclature) for all his species. [Georges-Louis Leclerc, Comte de Buffon](http://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon), treated species as artificial categories and living forms as malleable—even suggesting the possibility of [common descent](http://en.wikipedia.org/wiki/Common_descent). Though he was opposed to evolution, Buffon is a key figure in the [history of evolutionary thought](http://en.wikipedia.org/wiki/History_of_evolutionary_thought); his work influenced the evolutionary theories of both [Lamarck](http://en.wikipedia.org/wiki/Lamarck) and [Darwin](http://en.wikipedia.org/wiki/Charles_Darwin).

The discovery of the physical representation of heredity came along with evolutionary principles and [population genetics](http://en.wikipedia.org/wiki/Population_genetics). In the 1940s and early 1950s, experiments pointed to [DNA](http://en.wikipedia.org/wiki/DNA) as the component of [chromosomes](http://en.wikipedia.org/wiki/Chromosomes) that held the trait-carrying units that had become known as [genes](http://en.wikipedia.org/wiki/Genes). A focus on new kinds of model organisms such as [viruses](http://en.wikipedia.org/wiki/Viruses) and [bacteria](http://en.wikipedia.org/wiki/Bacteria), along with the discovery of the double helical structure of DNA in 1953, marked the transition to the era of [molecular genetics](http://en.wikipedia.org/wiki/Molecular_genetics). From the 1950s to present times, biology has been vastly extended in the [molecular](http://en.wikipedia.org/wiki/Molecular_Biology) domain. The [genetic code](http://en.wikipedia.org/wiki/Genetic_code) was cracked by [Har Gobind Khorana](http://en.wikipedia.org/wiki/Har_Gobind_Khorana" \o "Har Gobind Khorana), [Robert W. Holley](http://en.wikipedia.org/wiki/Robert_W._Holley) and [Marshall Warren Nirenberg](http://en.wikipedia.org/wiki/Marshall_Warren_Nirenberg) after DNA was understood to contain [codons](http://en.wikipedia.org/wiki/Codons" \o "Codons). Finally, the [Human Genome Project](http://en.wikipedia.org/wiki/Human_Genome_Project) was launched in 1990 with the goal of mapping the general human [genome](http://en.wikipedia.org/wiki/Genome). This project was essentially completed in 2003, with further analysis still being published. The Human Genome Project was the first step in a globalized effort to incorporate accumulated knowledge of biology into a functional, molecular definition of the human body and the bodies of other organisms.

Branches of Biology…

These are the main branches of biology:

* [Aerobiology](http://en.wikipedia.org/wiki/Aerobiology) – the study of airborne organic particles.
* [Anatomy](http://en.wikipedia.org/wiki/Anatomy) – the study of form and function, in plants, animals, and other organisms, or specifically in humans.
  + [Histology](http://en.wikipedia.org/wiki/Histology) – the study of cells and tissues, a microscopic branch of anatomy.
* [Biochemistry](http://en.wikipedia.org/wiki/Biochemistry) – the study of the chemical reactions required for life to exist and function, usually a focus on the cellular level.
* [Bioengineering](http://en.wikipedia.org/wiki/Bioengineering) – the study of biology through the means of engineering with an emphasis on applied knowledge and especially related to biotechnology.
* [Biogeography](http://en.wikipedia.org/wiki/Biogeography) – the study of the distribution of species spatially and temporally.
* [Biomedical research](http://en.wikipedia.org/wiki/Biomedical_research) – the study of health and disease.
  + [Pharmacology](http://en.wikipedia.org/wiki/Pharmacology) – the study and practical application of preparation, use,
  + and effects of drugs and synthetic medicines.
* [Biomusicology](http://en.wikipedia.org/wiki/Biomusicology) – the study of music from a biological point of view.
* [Biophysics](http://en.wikipedia.org/wiki/Biophysics) – the study of biological processes through physics, by

applying the theories and methods traditionally used in the physical sciences.

* [Biotechnology](http://en.wikipedia.org/wiki/Biotechnology) – the study of the manipulation of living matter, including genetic modification and [synthetic biology](http://en.wikipedia.org/wiki/Synthetic_biology).
  + [Synthetic Biology](http://en.wikipedia.org/wiki/Synthetic_Biology) – research integrating biology and engineering; construction of biological functions not found in nature.
* [Building biology](http://en.wikipedia.org/wiki/Building_biology) – the study of the indoor living environment.
* [Botany](http://en.wikipedia.org/wiki/Botany) – the study of plants.
* [Cell biology](http://en.wikipedia.org/wiki/Cell_biology) – the study of the cell as a complete unit, and the molecular and chemical interactions that occur within a living cell.
* [Developmental biology](http://en.wikipedia.org/wiki/Developmental_biology) – the study of the processes through which an organism forms, from zygote to full structure.
  + [Embryology](http://en.wikipedia.org/wiki/Embryology) – the study of the development of embryo (from fecundation to birth).
* [Ecology](http://en.wikipedia.org/wiki/Ecology) – the study of the interactions of living organisms with one another and with the non-living elements of their environment.
* [Environmental biology](http://en.wikipedia.org/wiki/Environmental_biology) – the study of the natural world, as a whole or in a particular area, especially as affected by human activity.
* [Epidemiology](http://en.wikipedia.org/wiki/Epidemiology) – a major component of public health research, studying factors affecting the health of populations.
* [Evolutionary biology](http://en.wikipedia.org/wiki/Evolutionary_biology) – the study of the origin and descent of species over time.
* [Genetics](http://en.wikipedia.org/wiki/Genetics) – the study of genes and heredity.
* [Hematology](http://en.wikipedia.org/wiki/Hematology) (also known as Haematology) – the study of blood and blood-forming organs.
* [Marine biology](http://en.wikipedia.org/wiki/Marine_biology) (or Biological oceanography) – the study of ocean ecosystems, plants, animals, and other living beings.
* [Microbiology](http://en.wikipedia.org/wiki/Microbiology) – the study of microscopic organisms (microorganisms) and their interactions with other living things.
  + [Parasitology](http://en.wikipedia.org/wiki/Parasitology) – the study of parasites and parasitism.
  + [Virology](http://en.wikipedia.org/wiki/Virology) – the study of viruses and some other virus-like agents.
* [Molecular biology](http://en.wikipedia.org/wiki/Molecular_biology) – the study of biology and biological functions at the molecular level, some cross over with biochemistry.
* [Mycology](http://en.wikipedia.org/wiki/Mycology) – the study of fungi.
* [Neurobiology](http://en.wikipedia.org/wiki/Neurobiology) – the study of the nervous system, including anatomy, physiology and pathology.
* [Population biology](http://en.wikipedia.org/wiki/Population_biology) – the study of groups of conspecific organisms, including
  + [Population ecology](http://en.wikipedia.org/wiki/Population_ecology) – the study of how population dynamics and extinction.
  + [Population genetics](http://en.wikipedia.org/wiki/Population_genetics) – the study of changes in gene frequencies in populations of organisms.
* [Pathobiology or pathology](http://en.wikipedia.org/wiki/Pathology) – the study of diseases, and the causes, processes, nature, and development of disease.
* [Physiology](http://en.wikipedia.org/wiki/Physiology) – the study of the functioning of living organisms and the organs and parts of living organisms.
* [Psychobiology](http://en.wikipedia.org/wiki/Psychobiology) – the study of the biological bases of [psychology](http://en.wikipedia.org/wiki/Psychology).
* [Structural biology](http://en.wikipedia.org/wiki/Structural_biology) – a branch of [molecular biology](http://en.wikipedia.org/wiki/Molecular_biology), [biochemistry](http://en.wikipedia.org/wiki/Biochemistry), and [biophysics](http://en.wikipedia.org/wiki/Biophysics) concerned with the molecular structure of biological macromolecules.
* [Zoology](http://en.wikipedia.org/wiki/Zoology) – the study of animals, including classification, physiology, development, and behavior. Subbranches include: [Ethology](http://en.wikipedia.org/wiki/Ethology" \o "Ethology)(animal behavior), [Entomology](http://en.wikipedia.org/wiki/Entomology)(insects),[Herpetology](http://en.wikipedia.org/wiki/Herpetology)(reptiles and amphibians), [Ichthyology](http://en.wikipedia.org/wiki/Ichthyology)(fish), [Mammalogy](http://en.wikipedia.org/wiki/Mammalogy" \o "Mammalogy)(mammals), and [Ornithology](http://en.wikipedia.org/wiki/Ornithology)(birds).