Microbiology

Microbiology is the study of small organisms called microorganisms or microbiota (the unseen world of living things).

In the late 1600's and early 1700's primitive microscopes existed. The Father of Microbiology, Anton van Leeuwenhoek, was a Dutch merchant and an amateur lens maker. He made a microscope by grinding lenses and putting them together in a way that they magnified an image 300X with little distortion.

Leeuwenhoek was the first person to observe living microorganisms and he referred to them as "animalcules". He found the microorganisms in many different environments, such as stagnant water, sea water, his mouth, scrapings from between his teeth, and in sick people. During his lifetime he observed bacteria, protozoa, algae, yeast, and fungi.

During the span of the next Century, there was controversy over the theories of spontaneous generation and biogenesis. Spontaneous generation was the belief that living organisms arise from non-living matter. Biogenesis is the belief that living cells arise from preexisting cells.

The Golden Age of Microbiology existed from the mid-1800's to the early 1900's and involved rapid advances that led to microbiology as a science.

During this time:

a. microorganisms were identified as the cause of diseases
b. vaccines were produced
c. surgical techniques and aseptic surgery were developed
d. the role of immunity in the prevention and cure of diseases was identified
e. chemical activities of organisms were studied
f. improved techniques for perfecting microscopy and culturing microorganisms were developed
g. spontaneous generation was disproved

Louis Pasteur and Robert Koch were prominent scientists during this time period.

Louis Pasteur performed a series of experiments which proved microorganisms produce disease in other organisms, they cause plant and animal tissues to decompose, they cause food to spoil, and they are found virtually everywhere.

Once spontaneous generation was disproved, the field of microbiology changed from an observable science to an experimental science. The germ theory of disease, which simply means that microorganisms cause infectious diseases, became popular.
Robert Koch provided a method of establishing the germ theory of disease which has become known as Koch's Postulates. The method involves four steps to establish that a microorganism is the causative agent of a disease:

1. The specific microorganism causing the disease must be found in every case of the disease, but not in a healthy organism.

2. The disease-causing microorganism must be isolated in a pure culture (free of other microorganisms).

3. Inoculation of a sample of the pure culture into a healthy susceptible organism must produce the same disease.

4. The disease-causing microorganism must be recovered from the newly infected organism.

Principles of Classification

Living organisms are diverse and they are organized and classified based on similarities in their structures and other characteristics. The classification system begins with dividing organisms based on general characteristics they have in common. Each group is further subdivided based on more and more specific characteristics they have. Eventually a single organism is identified.

Kingdom (broadest, most general)

Phylum(a) or Division(s)

Class(es)

Order(s)

Family(ies)

Genus (Genera)

Species (most specific)
Organisms are named using **binomial nomenclature** (two names) which are the **genus** and **species**. The **genus** is a noun, capitalized and written in italics, or underlined. It may be abbreviated by using the capitalized first letter. The **species** is an adjective, not capitalized or abbreviated, and is written in italics or underlined.

_Escherichia coli_ or _E. coli_

Organisms are placed in Kingdoms based on three major characteristics:

1. **cell type**
   
   a. **prokaryotic** ("before nucleus") - The genetic material (DNA) is found freely floating in the cytoplasm of the cell and is not enclosed in a membrane. They also lack membrane-bound organelles.

   b. **eukaryotic** ("true nucleus") - The genetic material (DNA) is contained within a membrane-surrounded organelle called a **nucleus**. The nucleus is the control center of the cell.

2. **number of cells**

   a. **unicellular** - a single cell which functions independently of other cells.

   b. **multicellular** - two or more cells which interact and communicate with one another. It allows for increased specialization.

3. **acquisition of food and energy**

   a. **autotrophic** ("self-feeders") - They use light energy and convert it into usable chemical energy (photosynthesis).

   b. **heterotrophic** ("other feeders") - They feed off of other organisms (consumers) or dead and decaying organic matter (decomposers).
In 1969, Robert Whittaker proposed a five-kingdom classification system:

**Kingdom Monera** (bacteria) - prokaryotic, unicellular, some autotrophic and some heterotrophic.

**Kingdom Protista** (protozoans) - eukaryotic, unicellular, some autotrophic and some heterotrophic.

**Kingdom Fungi** - eukaryotic, mostly multicellular (yeast are unicellular), heterotrophic (decomposers).

**Kingdom Plantae** - eukaryotic, multicellular, autotrophic.

**Kingdom Anamalia** (helminths) - eukaryotic, multicellular, heterotrophic (consumers).