

# MICROBIOLOGY

## Introduction

### What is Microbiology?

Microbiology is the study of living creatures too small to see with the naked eye. This division of biology includes the study of bacteria, fungi, protozoa, algae, viruses and other important minute organisms.

### Why Study Microbiology?

No living creature can separate itself from interaction with microbes. We use them to help create pharmaceuticals, clean up hazardous waste, and make food products. They can also wreak havoc on all creatures by invading them and causing disturbance and infection. Understanding the way they function is vital to life on earth.

## History of Microbiology

**1820** Deodorants used to reduce putrefaction. Sodium hypochlorite used in Parisian morgues to reduce decay.

**1840** Ignaz Semmelweis, a Viennese physician, was supervising medical students in the maternity wards when he noticed a correlation between putrefaction in autopsy and puerperal fever in pregnant women. He also noticed that some physicians found higher rates of puerperal fever in their patients. He, along with Oliver Wendell Holmes in the US, requested that all physicians wash their hands between patients. Few complied and many more women died in childbirth.

**1850** Louis Pasteur, a very bright brewer trying to make the best beer, noticed that it was microorganisms that fermented sugar to alcohol. When incorrect microbes were in the mixture, undesirable products resulted. He proceeded to culture *Bacillus anthracis* and proved it to be a causative agent of the disease anthrax.

**1860** Joseph Lister, an English surgeon, using data gathered in operating rooms and from old bandages he picked up in the trash outside hospitals, proposed that infections were due to "miasmas" found around patients. He began to use carbolic acid (phenol) to wrap wounds and to spray the air around the patient, which killed what he called "septic germs." His work went unappreciated for years.

**1890** Robert Koch, a German physician, continued Louis Pasteur's work. He established that anthrax bacteria was always present in infected blood, that the infected blood could transmit anthrax, and the bacteria was isolatable outside the animal.

**1940** Alexander Fleming discovered penicillin and used it to cure various diseases. Along with Ernst Chain and Howard Florey, he developed a production process.

**1950** Joshua Lederberg, Edward Tatum, and George Beadle discovered and worked on genetic recombination in bacteria.

**1960** Francois Jacob and Jacques Monod discovered and elucidated control of enzyme synthesis. They are credited with the Lac Operon model of genetic control of enzyme synthesis.

**1980** Michael Bishop and Harold Varmus discovered that virus encoded oncogenes originate in eukaryotic cells.

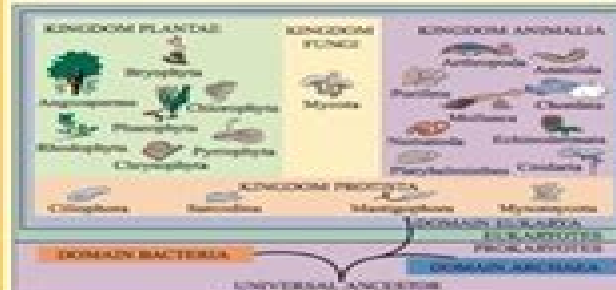
**1985** Kary Mullis invents PCR, polymerase chain reaction, a technique to amplify any DNA sequence.

**1997** Stanley Prusiner is awarded the Nobel Prize for work on prions, "infectious proteins."

## Types of Infective Agents

Bacteria	Mycoplasmas	L. Forms
Fungi	Rickettsias	Viruses
Viruses	Sporozoites	Prions
Protozoa	Chlamydiae	DNA/RNA

## Organismal Evolution



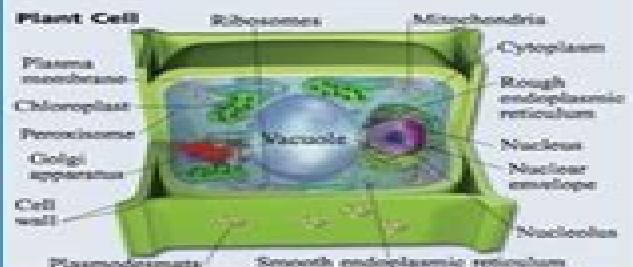
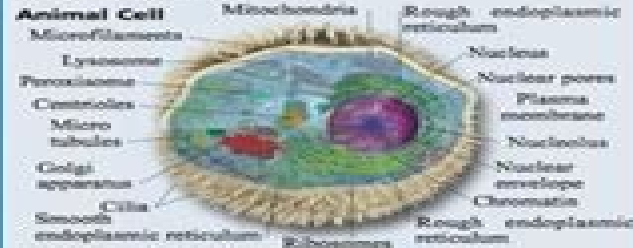
## How Prokaryotes and Eukaryotes Differ

### PROKARYOTES

No nucleus  
Simple membrane  
One chromosome  
Bacteria / Mycoplasma / Algae  
Small diameter / 1-5um  
No organelles  
Ribosomes are 70S  
Simple flagella  
Conjugation, transduction, transformation peptidoglycan in cell wall

### Eukaryotes

True nucleus  
Complex, invaginated membrane  
Multiple chromosomes  
Algae / Fungi / Protozoa  
Large diameter / 10-100um  
Organelles  
Ribosomes are 70S and 80S  
8 x 2 microtubular flagella conjugation  
No peptidoglycan



## The Cell Theory

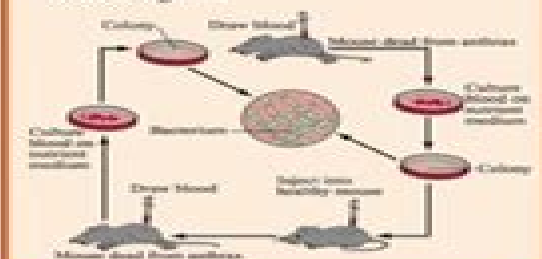
The cell theory, first put forth in the 1800's, has three main premises and states:

- A. All living things are made up of one or more cells.
- B. The cell is the basic unit of life.
- C. All cells come from pre-existing cells. A microbe can be one cell or a cluster or colony of cells that work together. Some pathogens are just infective pieces of RNA or DNA.

## Koch's Postulates

To prove a microorganism causes disease:

1. Identical microbe must be present in all individuals with the same disease.
2. Microbe must be cultured outside the body.
3. Microbe must induce disease when given to same species.
4. Identical microbe must be isolated from newly diseased organism.



## Food Borne Pathogens

### VIROSES

Norwalk  
Polio  
Coxsackie  
Echovirus  
Hepatitis A

### FUNGI

*Aspergillus*

### PROTOZOA

*Giardia*  
*Toxoplasma*  
*Cryptosporidium*  
*Salmonella*

### HELMINTHES

*Trichina*  
*Pinworm*  
*Tricostema*  
*Nematodes*

### BACTERIA

#### Gram Positive Genera

*Bacillus*  
*Clostridia*  
*Listeria*

#### Gram Negative Genera

*Escherichia*  
*Salmonella*  
*Shigella*  
*Yersinia*  
*Paratyphus*  
*Campylobacter*  
*Vibrio*  
*Bacteroides*  
*Brucella*

## GRAM NEGATIVE VS GRAM POSITIVE

### Food Borne Bacterial Symptoms:

Gram Positive (Usually Produce Toxins)

Headache, dizziness, uncoordinated movements, numbness and excessive incoherent

Gram Negative (Usually Result in Infection)

Abdominal cramps, malaise, tenesmus, diarrhea, hemorrhagic stool, vomiting and nausea

# Medical Microbiology Study Guide

**Terry C. Jones**



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