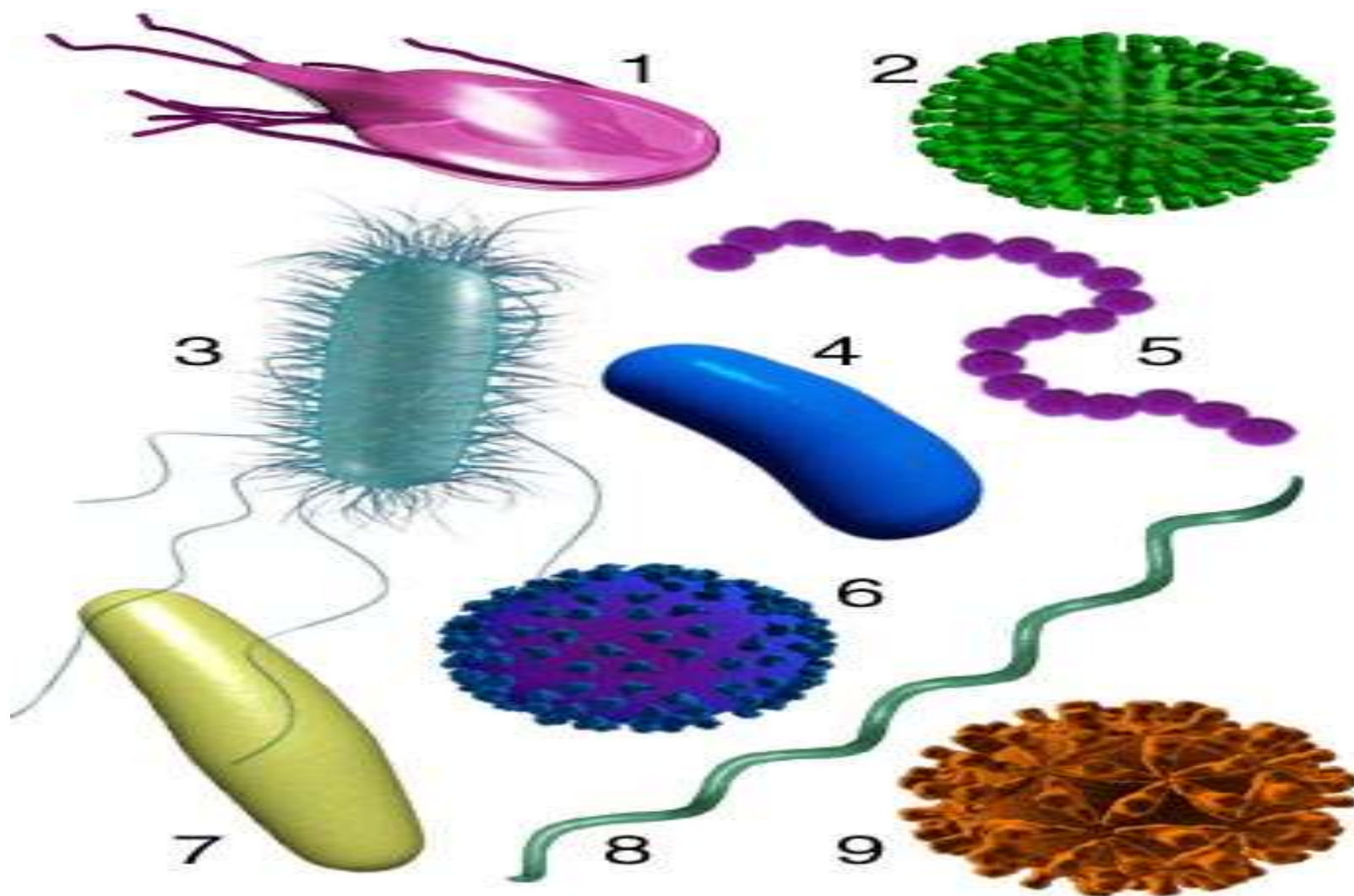


Introduction and History of Microbiology

By:

Alaaeldeen Balal Ahmed



COURSE OBJECTIVES

- To provide the basic knowledge of micro-organisms in general.
- To study the main characteristics of bacteria of medical importance.
- To learn a septic techniques.
- To provide an understanding of antimicrobial agents.

What is Microbiology?

- **Microbiology** is a Greek one: It is the study of very small organisms (microorganisms) that can not be seen by naked eye, but by microscope.
- **Micro** = very small, **Bio** = life, **Logy** = Science.
- **These microorganisms include four major groups:**
- **Bacteria:** studied under the name of “**Bacteriology**”.
- **Fungi:** studied under the name of “**Mycology**”.
- **Viruses:** studied under the name of “**Virology**”.
- **Protozoa:** studied under the name of “**Parasitology**” and “**Protozoology**”.

What is Microbiology?

- Definition: Microbiology is a branch of science that deals with the study of microbes which are living organisms of microscopic size.
- This term was introduced by a French chemist named Louis Pasteur.
- All microorganisms are smaller than 0.1 to 0.2 mm (200 microns) in diameter. With the naked eye we cannot see objects smaller than 200 microns. So we require microscope for their .

- Microbes are present everywhere (air, water, soil, etc). Only some of these microorganisms are disease producing or pathogenic. The majority do not cause disease and are non pathogenic.

MEDICAL MICROBIOLOGY

- **Medical Microbiology** is the study of microbes that infect humans, the diseases they cause, their diagnosis, treatment & prevention.
- It also deals with the response of the human host to microbial and other antigens.
- Microbes, or microorganisms are minute living things that are usually unable to be viewed with the naked eye.

MEDICAL MICROBIOLOGY

- **Importance of this science:**
 - Infection is one of the most important causes of mortality and morbidity in the population.
 - Approximately 30% of hospital patients are on antibiotics at any one time.
 - 1 in 10 patients acquires an infection while in hospital.

- Techniques necessary to isolate and culture microorganisms:
- Isolation / Sterilization / Culture in artificial media

- **Microbiologists may have a more applied focus:**
 - Medical** microbiology, including immunology
 - Food and dairy** microbiology
 - Public health** microbiology
 - Industrial** microbiology
 - Agricultural** microbiology

- Microbiologists may be interested in various characteristics or activities of microorganisms:
 - Microbial **morphology**
 - Microbial cytology
 - Microbial **physiology**
 - Microbial **ecology**
 - Microbial **genetics and molecular biology**
 - Microbial **taxonomy**

History of Microbiology

Antony Van Leeuwenhoek (1673-1723)

- Microorganisms were first seen by Antony Van Leeuwenhoek (pronounced as Layvenhook). Who was from Holland. He was a tailor but his hobby was to grind lenses and observe things through them. His microscope was a single biconvex lens that magnified 200 times. He found many microorganisms in materials like water, mud, saliva, teeth scraping and the stools. He recognized them as living because they swam about actively. He called them animalcules.





(b) Microscope replica

- He made various drawings which we now recognize as bacterial cocci and rods and stated that their size was $\frac{1}{6}$ of the blood cells. He sent his findings to the Royal Society of London in 1683 but it was only two centuries later that their importance came to be understood.

HISTORY OF MICROBIOLOGY

- **The Golden Age of Microbiology 1857-1914**

Beginning with **Louis Pasteur's work**, discoveries included the relationship between microbes and disease, immunity, and antimicrobial drugs.

Louis Pasteur (1822-1895)

- He is known as the **Father of Microbiology**. He has many contributions in the field of microbiology:
- He was a French chemist but was greatly interested in fermentation. His studies on fermentation established the presence and activity of different kinds of microorganisms.
- He established the **basic principles and techniques of Bacteriology**:
- He proved that all forms of life arose from life and not de novo (by itself) (disproved spontaneous generation)

- He introduced techniques of sterilization and developed hot air oven and autoclave.
- He said that different bacteria need different conditions for growth.
- He discovered the process of **attenuation** and development of live vaccines.
- **Attenuation:** It is the process of making a bacteria lose it`s ability to cause disease but retaining it`s ability to cause production of protective antibodies. This is a way of making

a live vaccine and this when introduced into the body protects the body from further attack by the bacteria. **He attenuated cultures of anthrax bacillus** by heating to high temperatures (42-43). This when introduced into animals protected them from infection with **anthrax**.

-**He first used the term vaccine** for the preparation of cow pox used by Edward Jenner for protection against smallpox.

-He also developed a **vaccine against Rabies**. Pasteur Institute, Paris is named after him.

- Microbial growth is also responsible for spoilage of food.
- **Pasteur** demonstrated that these spoilage bacteria could be killed by heat . This application of a high heat for a short time is called **pasteurization**.

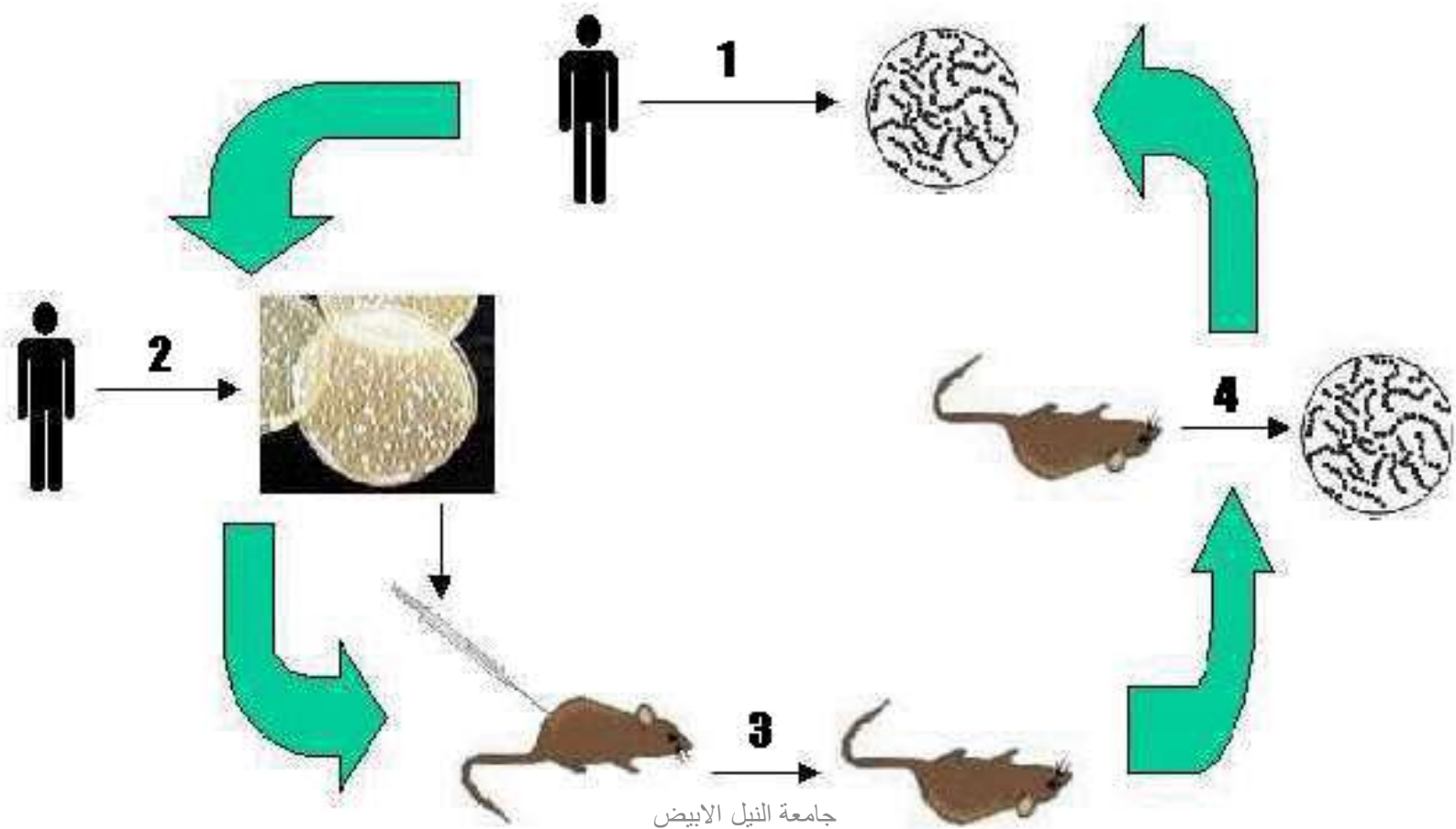


Robert Koch (1843-1910)

- He is known as the **Father of Bacteriology**.
- He established bacteriological techniques in Germany, during his studies on anthrax bacteria just as Louis Pasteur had done in France.
- He first used **solid media** for growing bacteria in pure culture.
- He introduced **staining techniques**.
- He discovered the bacteria of **tuberculosis** and **cholera** in 1882 and 1883 respectively and said that **different microorganisms cause different kinds of diseases**.

- Robert Koch is known for the **Koch's postulates**. According to this a microorganism can be **accepted as a causative agent** of an infectious disease only if the following conditions are satisfied. These were first indicated by Henle and later enunciated by Koch and are known as **Koch's postulates**:
 - The bacteria should always be present with the lesions of the disease.
 - It should be possible to isolate the bacterium in pure culture from the lesion.
 - When we inoculate the above culture into lab animals it should reproduce the lesions of the disease.

- It should be possible to reisolate the bacterium in pure culture from the lesions produced in experimental animals.



- Koch in 1890 observed that when **tubercle bacillus or its protein was injected** in guinea pig already infected with bacteria, an exaggerated response took place which was named as a hypersensitivity reaction known as **Koch's phenomenon**. This and other discoveries later led to the understanding of hypersensitivity.

Contributions and Achievements of other great scientists during that period

- Edward Jenner (1796):

Vaccination against smallpox. inoculated a person with **cow pox** virus. The person was then protected from **small pox**, (**vaccination**) from **vacca** = cow.

The protection is called **immunity**.

Chemotherapy – treatment with chemicals.

Chemotherapeutic agents used to treat infectious disease, can be synthetic drugs or antibiotics.

Antibiotics are chemicals produced by bacteria and fungi that inhibit or kill other microbes.

- Joseph Lister (1854):
 - Father of antiseptic surgery.
 - Techniques of antiseptic and aseptic surgery for prevention of wound sepsis.
- Hansen (1874):

Discovered *Leprosy Bacillus* which causative agent of leprosy.
- Koch (1876):

Discovered *Bacillus anthracis* which causative agent of anthrax.
- Laveran (1880)

Plasmodium sp –Malaria.
- Gaffky (1880)

Discovered *Salmonella typhi* which causative agent of typhoid fever.

- Ogston (1881) :
Discovered *Staphylococcus*.
- Koch (1882)
Discovered *Mycobacterium tuberculosis* which
causative agent of tuberculosis.
- Metchnikoff (1883):
Observed the phenomenon of phagocytosis
and established that it is a defense mechanism
against microbial invasion.

- Koch (1883)
Vibrio cholerae – Cholera
- Klebs and Loeffler (1883/4):
Discovered *Corynebacterium diphtheriae* which
causative agent of diphtheria.
- Nicolaier and Kitasato (1885)
Clostridium tetani- Tetanus.
- *Frankel (1886)
Discovered *Pneumococcus* (*Streptococcus
pneumoniae*)- *Pneumonia*.

- Van Ermengem (1886)
Clostridium botulinum- Botulism.
- Behring, Kitasato (1890):
Discovered antibodies.
- Ivanovsky (1892):
He was the first report a viral disease (Tobacco mosaic disease) in plants.
- Welch and Nuttall(1892)
Clostridium perfringens- Gas gangrene.

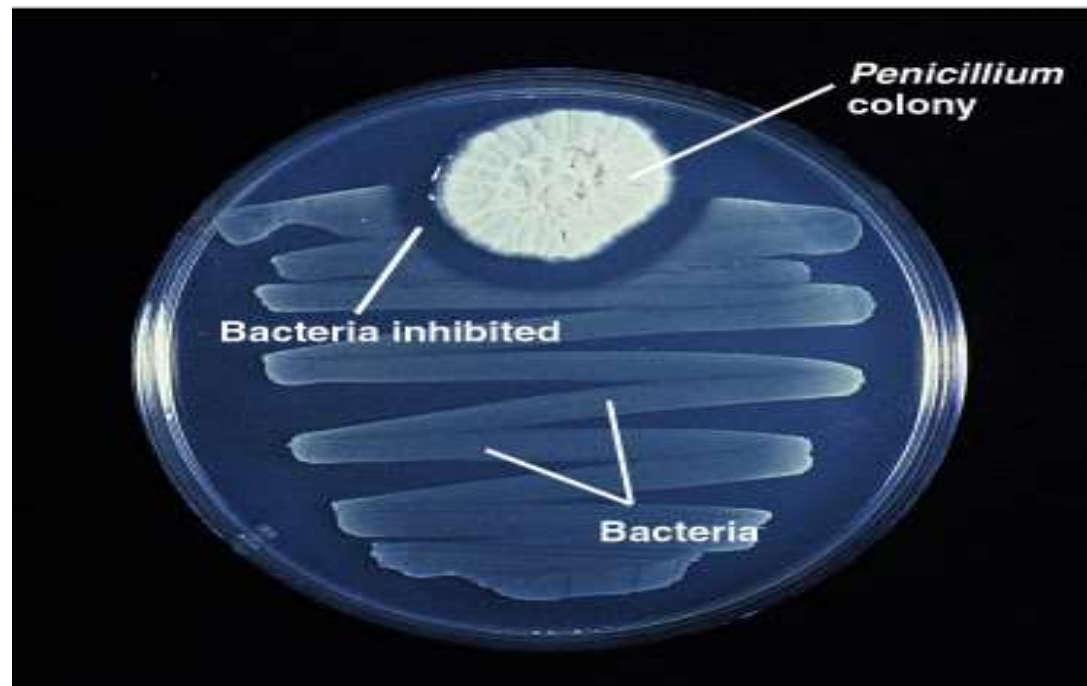
- Kitasato and Yersin (1894)
Yersinia pestis-Plague.
- Shiga (1898)
Shigella dysenteriae- Dysentery.
- Landsteiner (1900):
Discovered Blood Groups.
- Walter Reed (1902):
He proved that yellow fever had a viral etiology. It was the first human viral disease discovered.

- Hoffman and Schaudinn (1905)
Treponema pallidum- Syphilis.
- Bordet and Gengou (1906)
Bordetella pertussis- Whooping cough.
- Ricketts (1909)
Rickettsia rickettsii- Rocky Mountain spotted fever.
- Twort (1915) and d'Herelle:
Discovered bacteriophage.

- Alexander Fleming (1929):

Discovered Penicillin in 1929 , the first antibiotic and used in the 2nd war.

He observed that ***Penicillium*** fungus made an antibiotic **penicillin**, that killed ***S. aureus***.



- Goodpasture (1930):
He developed the technique of growing viruses on chick embryo.
- Ruska (1934):
Discovered electron microscope.
- Watson and Crick (1961):
Genetic code, structure of DNA.

Microorganisms and Diseases

- Microorganisms are of three types:

- **A- Free living**

Most microorganisms are free living in soil, water and air, and are not found on the human body. Some of these organisms obtain their energy from daylight and some from oxidation of inorganic matter.

- **B- Saprophytes**

These grow on dead decaying matter to obtain energy.

- **C- Parasites**

These are microorganisms that live in or on living host obtains its nourishment from them.

They are be divided into:

1- Commensal

2- Pathogenic

- **Commensal:**

These are normally found on the skin and mucous membranes of the upper respiratory tract, intestine and vagina , etc and obtain nourishment from the body secretions and food remains. These microorganisms are called normal flora. They are normally harmless because they do not enter the human body. In certain conditions, however when the body's defence mechanisms are weak they can enter the tissues and cause disease. Thus they act as ***opportunistic pathogens*** that is pathogenic only when the opportunity arises.

- **Pathogenic**

-Pathogenic microorganisms are those that can overcome the normal defences of the body and enter the tissues. They produce toxins and damage the tissues causing signs and symptoms of the disease.

-The process of microbial invasion of the body is called **infection**.

-Those infective diseases that are readily spread from person to person are called **infectious diseases** or **communicable diseases**.

Epidemiology of Diseases

- It is a study of the factors that influence the prevalence and distribution of diseases of the community. It includes the study of the source of infection, the mode of transmission from one person to another and the prevention of diseases.
- The source of infection is where the pathogenic organisms grow and multiply.
- Sources can be a clinical patient or a carrier.

- **A carrier** is a person who does not suffer from the disease himself but can transmit the disease to others.

- Here we are concerned with medical microbiology. We will study it under the following heads:

1. Bacteriology

It is the branch of medical microbiology that deals with the study of bacteria.

2. Virology

It is the branch of medical microbiology that deals with the study of viruses.

3. Mycology

It is the branch of medical microbiology that

Deals with the study of fungi.

- **Uses of studying Medical Microbiology:**
 - The knowledge of medical microbiology help us to find out the causative agents of diseases, their diagnosis, prevention and treatment.
 - Microorganisms are the smallest forms of living beings and serve as models for studies on genetics and biochemistry.