Importance of Microbiology and History of Microbiology

Introduction

Microbiology is the study of microorganisms, a large and diverse group of microscopic organisms that exist as single cells or cell clusters; it also includes viruses, which are microscopic but not cellular .Microbiology include bacteria, parasites, viruses, prions, algae and fungi. Such organisms are so minute that they can only be viewed through a microscope. Yet while they may be invisible to the naked eye .

The "Branches" of Microbiology;

Bacteriologists - study bacteria, there are medical, agricultural, biotechnological specializations.

Mycologists - study fungi, there are medical, agricultural, biotechnological specializations.

Protozoologists, study small "animal - like" single celled organisms such as amoeba, and various disease causing parasites.

Phycologists study algae.

Parasitologists- a term generally used to describe those who study small animals as agents of disease (like some microscopic worms for instance) but also used to describe those who study protozoan pathogens.

Immunology is often taught and researched in microbiology faculties.

Importance of Microbiology

Microbiology research has been, and continues to be, central to meeting many of the current global aspirations and challenges, such as maintaining food, water and energy security for a healthy population on a habitable earth. Importance of microbiology including **:-**

- **Keeping the planet healthy**

Microbes are essentially protectors of the planet, ensuring that minerals such as carbon and nitrogen are incessantly recycled. They play a crucial role in keeping the atmosphere oxygenated and also actively degrade dead organic matter, thus transforming organic carbon back into carbon dioxide.

- **Agriculture**

When it comes to creating soils that can support crops and livestock, microbes are indispensable Studying microbiology helps farmers to optimise nitrate levels and maximise output.

- **Combating disease**

Infectious diseases have the capacity to wipe out entire populations, and microbiology is the key to keeping outbreaks under control. The study of microscopic organisms allows scientist to develop antibiotics and vaccines, with revelations such as Alexander Flemming's discovery of penicillin saving millions upon millions of lives.

- **Chemical products**

From antibiotics and solvents to preservatives and pharmaceuticals, microbes are used to create a myriad of useful products that we take for granted. Uncovering these chemical reactions and retailing them as commercial goods shapes the face of life as we know it.

- **Biotechnology**

Genetic engineering is an incredibly exciting revelation, and microbiology lies at the heart of the sphere. The scientific process of freely moving genes from one organism to another, isolating DNA and manipulating results is all hosted by bacteria.

Microbiology has come a long way since it was first pioneered by Dutch draper and hobbyist glass grinder Antonie Van Leeuwenhoek in the 17th century. **'A 'Dyeing' Art in Microbiology'** explores how the "Father of Microbiology" led us to discover the staining methods currently used in cytology, histology, haematology, microbiology and parasitological.

History of Microbiology

Scientists have studied microorganisms for more than 400 years. Their study has been enhanced by the invention of such instruments as the microscope. From the 16th century to the present, many theories have been developed about the growth and control of microorganisms.

A- 16th century

1- In 1546, Girolamo Fracastoro proposed the theory of contagious diseases

a. He believed that diseases were spread through contact between individuals

b. He developed this theory while treating cases of syphilis.

2. In 1590, Johannes and Zacharias Janssen invented the first compound microscope (one having two sets of lenses).

a. The Janssens used sunlight to illuminate the object under study

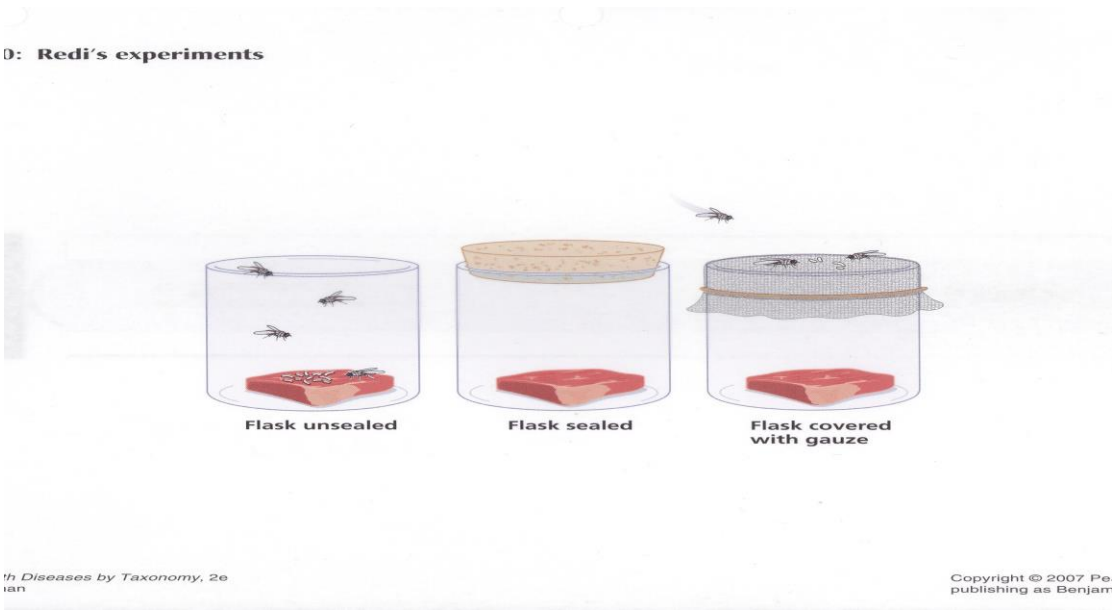
b. Their microscope achieved magnifications of 10 to 100 times the object's actual size.

B- 17th century: The debate of Spontaneous Generation begins

1- In 1660's **Francesco Redi** demonstrated that maggots resulted from flies laying eggs on rotting meat and not by spontaneous generation.

a. He covered jars of rotting meat covered with cloth to jars of rotting meat uncovered.

b. His work was not universally accepted except for another experiment 100 years later.



2- In 1665, **Robert Hooke** advanced the cell theory of biology

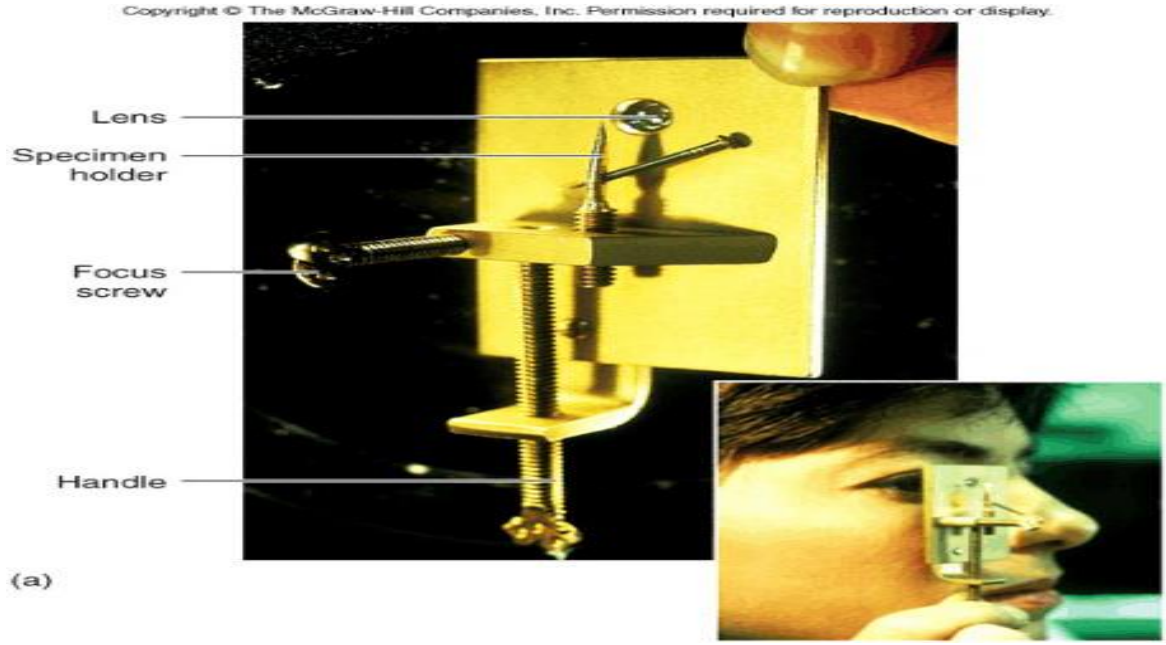
a. Hooke studied fungi and discovered cells

b. He proposed that cells are the basic unit of all living things: Beginning of the cell theory - that all living creatures are composed of cells

3. In 1674, **Antonie van Leeuwenhoek** used a microscope to describe microorganisms

a. Leeuwenhoek developed lenses capable of magnifying an object up to 270 times its actual size

b. He examined pond water and mouth scrapings to discover and record microorganisms .



C- 18th century: Debate over Spontaneous Generation continues

1- From 1740 to 1776, John Needham, and Lazzaro Spallanzani performed experiments involving spontaneous generation (life developing from nonliving materials)

a. In these experiments, various media grew microorganisms only when exposed to air, a source of bacteria and molds.

b. They theorized that all life came from existing life forms requiring some vital force (later to be shown to be oxygen)

2- Edward Jenner 1798 Jenner helped developed a vaccine for smallpox.

a. Jenner noted the similarity between smallpox and cowpox

b. He discovered that vaccination with the live virus of cowpox protected individuals from smallpox.

3- Agostino Bassi (1773 - 1856) : He discovery that microorganisms can be the cause of disease (stage set for the germ theory of disease). He discovered that the muscardine disease of silkworms was caused by a living, very small, parasitic organism, a fungus that would be named eventually *Beauveria bassiana* in his honor. In 1844, he stated the idea that not only animal(insect), but also human diseases are caused by other living microorganisms; for example, measles, syphilis, and the plague.

4- Theodor Schwan (1839) : Theodor Schwann also examined the question of spontaneous generation, which led to its eventual disproof. In the course of his experiments, he discovered the organic nature of yeast. In fact, the whole germ theory of Pasteur, as well as its antiseptic applications by Lister, can be traced to Schwann's influence.

5- John Tyndall (2 August 1820 – 4 December 1893): English physicist provide initial evidence that some of the microbes in dust and the air have high heat resistance requiring vigorous treatment to destroy them.

6- Ferdinand Julius Cohn (24 January 1828 – 25 June 1898) : Botanist/ Biologist Cohn first described bacterial endospores clarifying the reason why heat treatment sometimes failed to completely eliminate all microorganisms.

D- 19th century: Development of Germ Theory of Disease

1- In 1866, **Louis Pasteur** developed the process now known as pasteurization

a. Pasteurization uses moderate heat (below boiling) to destroy harmful microorganisms

b. This process does not chemically alter the substance being pasteurized

2- Between 1880 and 1885, Louis Pasteur developed vaccines

a- Pasteur worked with cholera and anthrax (bacterial infections) and rabies (a viral infection)

b. He found that attenuated (weakened) organisms could not cause infection but would produce immunity.

3- In 1867, Joseph Lister began using antiseptics in surgery

a. Lister experimented with the then-developing concept that microorganisms cause disease

b. He used phenol as an antiseptic on surgical wounds

4- In 1882, Robert Koch discovered the cause of tuberculosis and anthrax

a. Tuberculosis is caused by a bacterium

b. He became famous for isolating Bacillus anthracis (1877). Koch found anthrax built persisting endospores increasing its survival
odds.

c. Koch's studies led to the germ theory of disease

d. Koch's developed postulates establishing a specific microbe as the cause of an infective disease

Koch Postulate state:

1. The microbial agent must be present in every case of the disease host and absent in healthy host

2. The agent must be isolated from diseased host and cultured in vitro onto pure culture medium.

3. The disease must be reproduced when a pure culture of the agent is inoculated into a similar susceptible host.

4. The agent must be recoverable from the experimentally-infected host and isolated to pure culture

5- In 1900, Walter Reed : He demonstrated that mosquitoes transmitted yellow fever

a. Yellow fever is caused by a virus

b. The infection caused many deaths in the United States and Central America before being controlled through eradication of the mosquitoes that carried it

c. His insights helped opened entire new fields of epidemiology and bio medicine and most immediately allowed the resumption and completion of work on the Panama Canal (1904-14) by the United States.

E- 20th century

1- In 1908, **Paul Ehrlich** introduced chemotherapy

a. Ehrlich sought a treatment for syphilis; He coined the term "chemotherapy" and the concept of a "magic bullet."

b. He developed Salvarsan, an arsenic compound that was specific and effective against syphilis.

c. He is credited with the first empirical observation of the blood-brain barrier and the development of the first antibiotic drug in modern medicine.

2- In 1929, Alexander Fleming was a Scottish biologist and pharmacologist. He discovered antibiotics

a. He made this discovery while working with a culture of *Staphylococcus aureus* that had become contaminated with the *Penicillium notatum*

b. After noting that the mold inhibited the growth of the bacteria, Fleming isolated the antibiotic penicillin .

3- Gerhard Johannes Paul Domagk (1932)

a. Domagk was a German pathologist and bacteriologist credited with the discovery of Sulfonamidochrysoidine – the first commercially available antibacterial antibiotic for which he received the 1939 Nobel Prize in Physiology or Medicine.

b. He found the sulfonamide Prontosil to be effective against streptococcus, and treated his own daughter with it, saving her the amputation of an arm.

4- In 1933, Ernst Ruska developed the electron microscope

a. To illuminate objects for study, Ruska used a beam of electrons rather than sunlight, focusing the beam with electrical lenses

b. The electron microscope has permitted scientists to magnify an object millions of times its actual size.

5- In 1952, Jonas Salk tested a vaccine against polio

a. Polio is caused by a virus

b. Salk killed the polio virus, but kept it intact enough to trigger the necessary immune response.