# ALHAMD EDUCATIONAL SYSTEM

ONLINE CLASSES

# LECTURE 1

Subject: Biology

Class: pre 9th

Chapter : 4

Topic: 1

Date: 10 august 2020

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## 4.1 MICROSCOPY AND THE EMERGENCE OF CELL THEORY

The use of microscope is known as microscopy. The first compound microscope was developed by Zacharias Janssen, in Holland in 1595. It was simply a tube with lenses at each end and its magnification ranged from 3X to 9X.

Two important terms are used in microscopy i.e. magnification and resolving power. **Magnification** is the increase in the apparent size of an object and it is an important factor in microscopy. **Resolving power** or **resolution** is the measure of the clarity of an image. It is the minimum distance at which two objects can be seen as separate objects. Human naked eye can differentiate between two points, which are at least 0.1 mm apart. This is known as the resolution of human eye. If we place two objects 0.05 mm apart,

# Light microscope

Parts of microscope

- Illuminator - This is the light source located below the specimen.
- Condenser - Focuses the ray of light through the specimen.
- Stage - The fixed stage is a horizontal platform that holds the specimen.
- Objective - The lens that is directly above the stage.
- Nosepiece - The portion of the body that holds the objectives over the stage.
- Iris diaphragm - Regulates the amount of light into the condenser.
- Base – Base supports the microscope which is horseshoe shaped.
- Coarse focusing knob - Used to make relatively wide focusing adjustments to the microscope.
- Fine focusing knob - Used to make relatively small adjustments to the microscope.
- Body - The microscope body.
- Ocular eyepiece - Lens on the top of the body tube. It has a magnification of 10× normal vision.

human eye would not be able to differentiate them as two separate objects. Magnification and resolution can be increased with the help of lenses.

## 4.1.1 LIGHT MICROSCOPY AND ELECTRON MICROSCOPY

Now two types of microscope i.e. light microscope (LM) and electron microscope (EM) are used in microscopy.

### Light Microscope (LM)

A light microscope works by passing visible light through a specimen. It uses two glass lenses. One lens produces an enlarged image of the specimen and the second lens magnifies the image and projects it into viewer's eye or onto photographic film. A photograph taken through a microscope is called a **micrograph**.

When we see a micrograph on the page of a book, we see some words like "LM 109X" printed along the edge of the micrograph. It tells us that the photomicrograph was taken through a light microscope and that the image has been magnified 109 times.

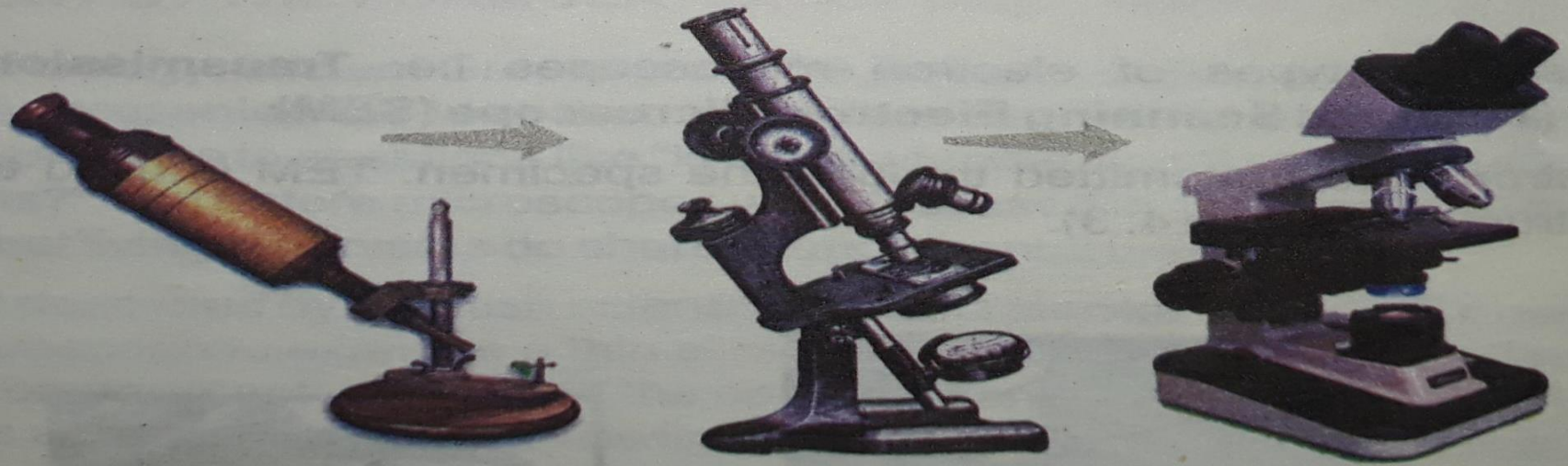

**Figure 4.1: Light microscopes: From earlier (left) to the latest (right)**

A light microscope can magnify objects only about 1500 times without causing blurriness i.e. its magnification is **1500X**. Its resolving power is **0.2 micrometer** (μm) and 1μm = 1/1000 mm. In other words, the LM cannot resolve (distinguish) objects smaller than 0.2 μm. It is about the size of the smallest bacterium. The image of bacterium can be magnified many times, but light microscope cannot show the details of its internal structure.

**Figure 4.2: Light microscopic view; amoebae (left), unicellular algae (right)**

## Electron Microscope (EM)

It is the most advanced form of microscope. In EM object and lens are placed in a vacuum chamber and a beam of electrons is passed through object. Electrons pass through or are reflected from object and make image. Electromagnetic lenses enlarge and focus the image onto a screen or photographic film.

Electron microscope has much higher resolving power than light microscope. The most modern EM can distinguish objects as small as **0.2 nanometer** (nm) and 1 nm = 1/1000,000 mm. It is a thousand-fold improvement over LM. EM can magnify objects about 250,000 times. Under special conditions EM can detect individual atoms. Cells, organelles and even molecules like DNA and protein are much larger than single atoms.

EM has revolutionized the study of cells and organelles but it cannot be used to study life processes, because the specimen must be held in a vacuum chamber i.e. all air must be removed. To study the life processes e.g. movement of *Amoeba* a light microscope is better.

Biologists use two types of electron microscopes i.e. **Transmission Electron Microscope (TEM)** and **Scanning Electron Microscope (SEM)**.

In TEM, electrons are transmitted through the specimen. TEM is used to study the internal cell structure (Figure 4. 3).

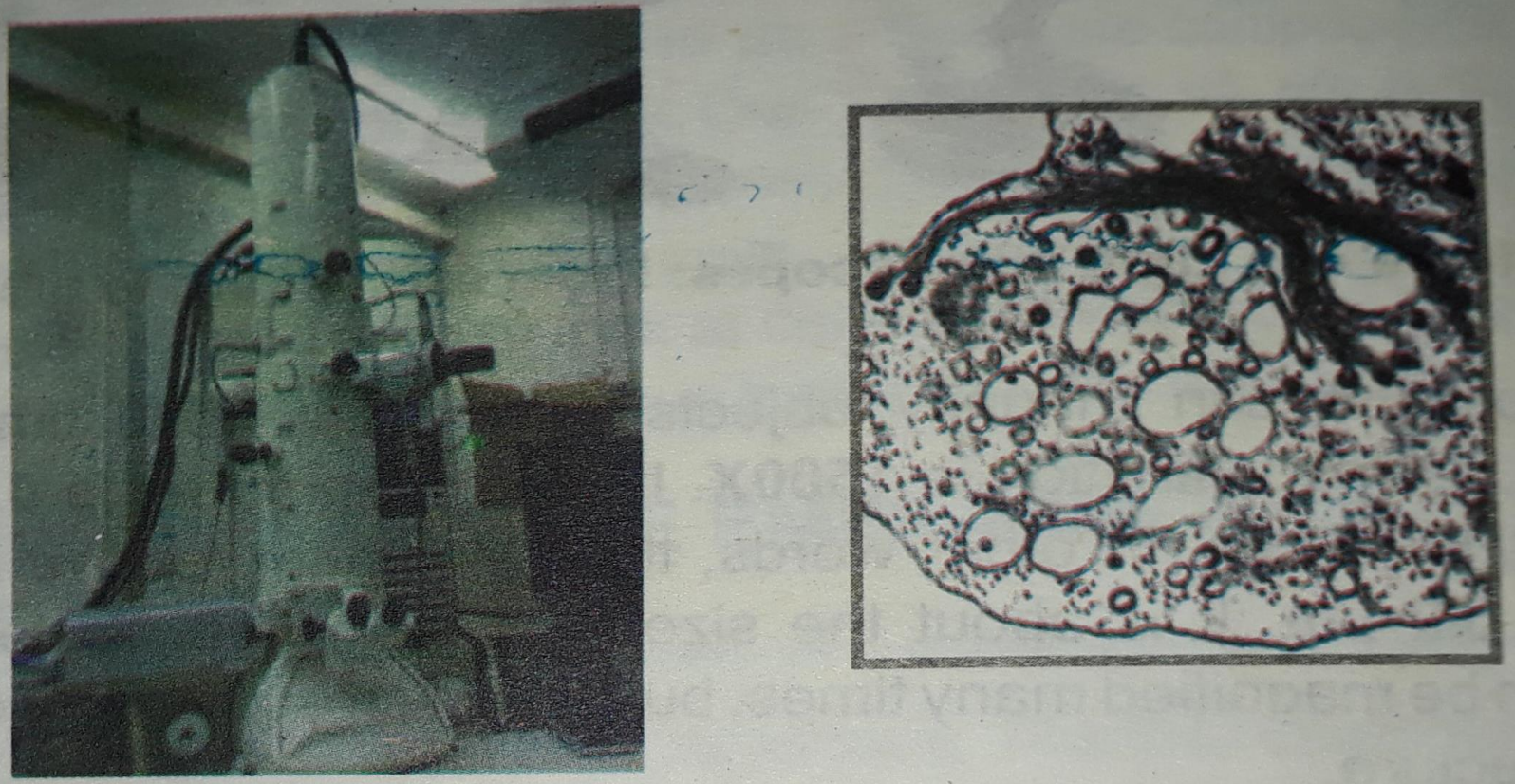

**Figure 4.3: TEM (left) and view of an animal cell (right) through it**

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Which type of microscope would you use to study: (a) the changes in shape of a human white blood cell; (b) the surface texture of human hair; (c) the detailed structure of a mitochondrion in the cell of human liver?

(a) LM; (b) SEM; (c) TEM

## 4.1.2 HISTORY OF THE FORMULATION OF CELL THEORY

In the history of biology, ancient Greeks were the first who organized the data of natural world. **Aristotle** presented the idea that all animals and plants are somehow related. Later this idea gave rise to questions like "is there a fundamental unit of structure shared by all organisms?". But before microscopes were first used in 17th century, no one knew with certainty that living organisms do share a fundamental unit i.e. cell.

Cells were first described by a British scientist, **Robert Hooke** in 1665. He used his self-made light microscope to examine a thin slice of cork. Hooke observed a "honeycomb" of tiny empty compartments. He called the compartments in cork as "cellulae". His term has come to us as cells (Figure 4.5). The first living cells were observed a few years later by Dutch naturalist **Antonie van Leeuwenhoek**. He observed tiny organisms (from pond water) under his microscope and called them as "animalcules".

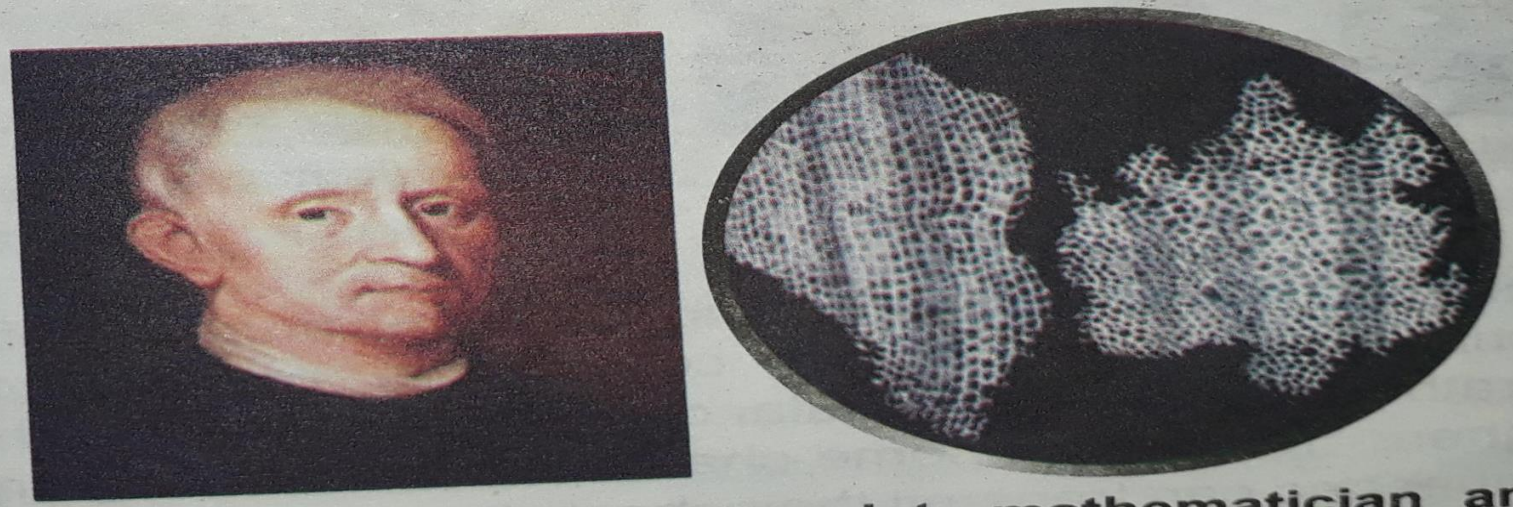

**Figure 4.5: Robert Hooke was a chemist, mathematician and physicist.** His remarkable engineering abilities enabled him to invent and improve many mechanical devices, including timepieces, the quadrant, and the Gregorian telescope. His observation about the section of cork is also illustrated here.

# ALLAH HAFIZ

Thank u