



Microbiology

INTRODUCTION

Microbiology is the study of organisms that are visible only with a microscope.

HISTORY OF MICROBIOLOGY

- Robert Hooke:** first described cells in 1665 when he used a microscope to observe a slice of cork.
- Anton van Leeuwenhoek:** discovered microscopical life forms in droplets of pond water and on his teeth. In 1683, he called these organisms "animalcules."
- Louis Pasteur:**
 - identified microorganisms as the cause of alcoholic fermentation and curing dairy products.
 - improved the notion of spontaneous generation—the idea that organisms may arise from lifeless matter, such as beef soup.
 - proposed the **germ theory of disease**, which states that microorganisms cause infectious diseases.

- Developed immunization techniques.
- Robert Koch:** proved Pasteur's germ theory of disease through experiments with cattle, anthrax, and cholera, and coined the **Koch's postulates**.

- The same microorganisms are observed in every case of the disease.
- The microorganisms are isolated and cultured outside the body of the sick animal.
- The microorganism is injected into a healthy animal of the same species, causing the same illness.
- An identical microorganism is isolated from the newly sick animal.



THE CELL THEORY

Every living organism is made up of cells, which are the lowest level of structure capable of performing all the activities of life. All cells arise from preexisting cells.

PROKARYOTIC VS. EUKARYOTIC MICROORGANISMS

Several cell components exist in all types of cells.

- Cell membrane:** serves as an external barrier and protects organelles.
 - The basic unit is a **phospholipid molecule**, with a polar phosphate group as its hydrophilic head and two non-polar fatty acid chains as hydrophobic tails.
 - Individual phospholipids form a fluid **phospholipid bilayer**, with hydrophilic heads facing out, and hydrophobic tails facing in to form a bilayer (one that separates the watery cell exterior from the watery cellular environment).
 - Cell membranes are **semipermeable**, allowing passage of gases, liquids, and small polar molecules. Cell membranes are not permeable to charged molecules (ions and proteins) and large polar molecules.
- Membrane proteins:** protein molecules embedded in the lipid bilayer. Membranes unable to cross the membrane cannot be located in biologically important reactions, and interact with membranes of neighboring cells.
- Cytoplasm:** a semifluid medium called **cytosol** and all the organelles inside the plasma membrane but outside the nucleus.
- Cytoskeleton:** system of protein filaments in the cytoplasm

including **microtubules** and **microfilaments** that gives the cell shape and helps direct movement.

- Ribosomes:** proteins that work with RNA to synthesize polypeptides.

PROKARYOTES

The simplest prokaryotic organisms are the smallest cells to evolve (**bacteria**). They have **distinctive features** from eukaryotes include:

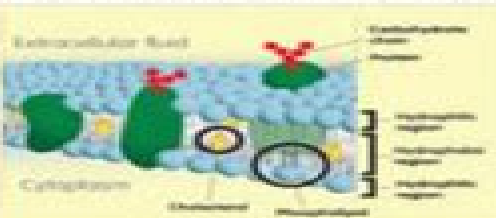
- Genetic material floats in the cytoplasm in a concentrated but unbound region called the **nucleoid**.
- No membrane-bound organelles.



EUKARYOTES

Found in unicellular organisms and multicellular plants and animals, eukaryotic organisms have a nucleus and other membrane-bound organelles, each of which performs a specific function and increases efficiency.

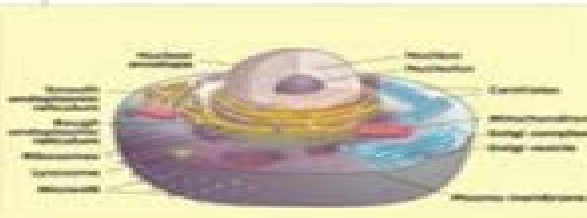
- Nucleus:** the storage site of genetic information that determines heredity and directs the activities of a cell.
- Mitochondria:** double-membraned power plants of the cell. Location of aerobic respiration.
- Smooth-surfaced endoplasmic reticulum (SER/ROE):** a network of membranes covered with ribosomes where lipid/protein are synthesized.
- Grain complex (or a grain apparatus):** packages proteins and lipids produced in the cell for export in secretory vesicles.
- lysosomes:** sacs in which substances are transported or stored.
- Glyoxysomes:** organelles of digestion enzymes that degrade and cellular components.
- Special plant organelles:** plant cells contain additional components:
 - Chloroplasts:** site of photosynthesis, contain chlorophyll to green pigment and have a double membrane.
 - Vacuoles:** large vesicle used to store water, proteins, and waste.
 - Cell wall:** a rigid layer of cellulose surrounding the cell membrane.



CELL MEMBRANE



PLANT CELL



ANIMAL CELL

METABOLISM

CELLULAR RESPIRATION

Cellular process of oxidizing glucose or food molecules to obtain energy in the form of **adenosine triphosphate (ATP)**.

GLYCOLYSIS

The oldest metabolic pathway, used by all cells, and a precursor to both the aerobic and anaerobic respiratory pathways. Glycolysis occurs in the cytoplasm. The six-carbon sugar glucose is degraded to two three-carbon molecules of pyruvate, resulting in two NADH and two net ATP.

FERMENTATION

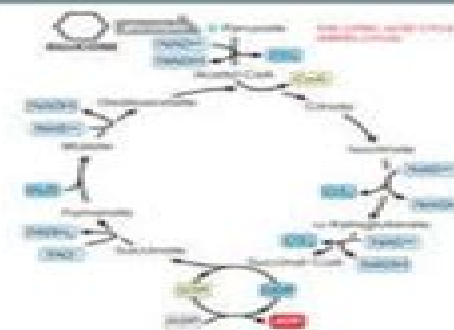
In the absence of oxygen, respiration relies on glycolysis to produce ATP. The **anaerobic** process uses an organic molecule to accept the electrons from NADH and returns NAD⁺ for glycolysis to run again. Much energy remains in bonds of the products, such as ethanol or lactic acid. Three types of fermentation exist.

- Homofermentation:** bacteria converts pyruvate to lactic acid.
- Allofermentation:** yeast and bacteria convert pyruvate into ethanol and CO₂.
- Heterofermentation:** organisms produce lactic acid as well as other acids and alcohols.

Oxidative RESPIRATION

If oxygen is present, glycolysis leads to **aerobic** respiration, which produces a net total of 36 ATP per molecule of glucose.

- Oxidation of pyruvate:** Carbon dioxide splits off from pyruvate to produce acetyl-CoA and NADH.
- Citric acid cycle (Krebs cycle):** begins with acetyl-CoA joining molecules and to form citrate acid, which is oxidized to CO₂, yielding ATP, NADH, and FADH₂. Oxidizable acid is regenerated for another cycle. Occurs in the mitochondrial matrix and the cytoplasm of aerobic prokaryotes.



Microbiology Sparkcharts

Wesley A. Volk, Margaret F. Wheeler



Microbiology Sparkcharts:

The Top Books of the Year Microbiology Sparkcharts The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous compelling novels enthralling the hearts of readers worldwide. Lets delve into the realm of bestselling books, exploring the fascinating narratives that have enthralled audiences this year.

The Must-Read : Colleen Hoover's "It Ends with Us" This heartfelt tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover skillfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can prevail.

Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This intriguing historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery.

Discover the Magic : Delia Owens "Where the Crawdads Sing" This evocative coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens spins a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting.

These bestselling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered.

The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and thrilling novel that will keep you wondering until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

<https://crm.allthingsbusiness.co.uk/results/detail/HomePages/Network%20Attacks%20And%20Exploitation%20A%20Framework.pdf>

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