



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 microscopic 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 theory 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 **four postulates**.

THE CELL THEORY

- 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 microorganisms are injected into a healthy animal of the same species, causing the same disease.
- An sterile 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 cytoplasmic 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 that are unable to cross the membrane easily. Some are **transmembrane proteins**, which span the membrane 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.

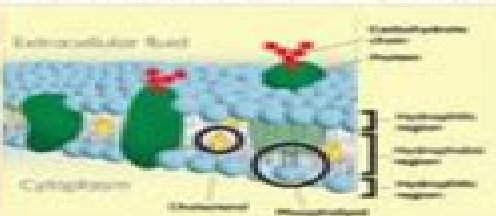
- Genetic material:** located in the cytoplasm in a concentrated but unbound region called the **nucleoid**.
- No membrane-bound organelles.**



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 directs cellular function 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.
- Flagellar complex:** a **flagellar apparatus** packages proteins and lipids produced in the cell for export in secretory vesicles.
- Proteasomes:** sites of cellular degradation and disposal of waste.
- Lysosomes:** organelles of digestion that degrade 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, resulting in two NADH and two net ATP.

FERMENTATION

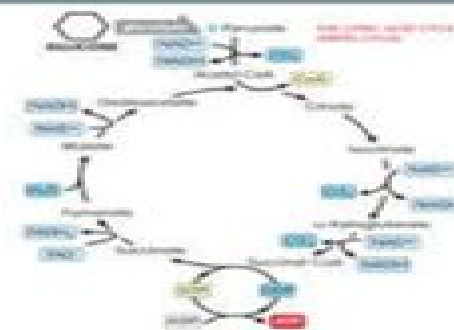
In the absence of oxygen, respiration relies on glycolysis to produce ATP. The **anaerobic** process uses an organic molecule to accept the electrons from NADH and returns NAD⁺ for glycolysis to run again. Much energy remains in bonds of the products, such as ethanol or lactic acid. Three types of fermentation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

**Luis M. de la Maza, Marie T.
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infectious diseases who want to learn more about their condition The concepts covered in this book contribute to UN Sustainable Development Goal 3 Health and Well Being Microbiology and Infection T. J. J. Inglis, David Speers, Michael J. Leung, 2002 This collection of picture tests on both clinical microbiology and infectious diseases illustrates laboratory diagnosis and clinical appearance Full explanatory answers are given at the end of the book **Atlas of Microbiology** A. Fuad Khan, 2010 Pearson Learning Solutions Title page verso Understanding Bacteria S. Srivastava, 2003-11-30 The discipline of microbiology that deals with an amazingly diverse group of simple organisms such as viruses archaea bacteria algae fungi and protozoa is an exciting field of Science Starting as a purely descriptive field it has transformed into a truly experimental and interdisciplinary science inspiring a number of investigators to generate th a wealth of information on the entire gamut of microbiology The later part of 20 century has been a golden era with molecular information coming in to unravel interesting insights of the microbial world Ever since they were brought to light through a pair of ground glasses by the Dutchman Antony van Leeuwenhoek in later half of 17th century they have been studied most extensively throughout the next three centuries and are still revealing new facets of life and its functions The interest in them therefore continues even in the 21 st century Though they are simple they provide a wealth of information on cell biology physiology biochemistry ecology and genetics and biotechnology They thus constitute a model system to study a whole variety of subjects All this provided the necessary impetus to write several valuable books on the subject of microbiology While teaching a course of Microbial Genetics for the last 35 years at Delhi University we strongly felt the need for authentic compiled data that could give exhaustive background information on each of the member groups that constitute the microbial world *Microbial Classification. Twelfth Symposium of the Society for General Microbiology Held at the Royal Institution, London, April 1962* Society for General Microbiology, 1962 Bacteria Trudy M. Wassenaar, 2011-11-03 A comprehensive reader friendly introduction to the world of bacteria When most people hear the word bacteria they think of food poisoning infections and acute debilitating or fatal diseases Yet while E coli strep and other bacterial pathogens certainly cause their share of misery in the world they are only a tiny portion of a vast universe of microorganisms the most basic of life forms Without them nothing else could live or grow on Planet Earth Bacteria The Benign the Bad and the Beautiful introduces you to this diverse microscopic world and explains the fundamental microbiological concepts you need to explore the life and behavior of bacteria Even if you have no previous background in the subject the book s clear jargon free language tells you what you need to know about The origins and evolution of bacteria Some of the fundamental ways in which bacteria have shaped the world Bacteria commonly found in the healthy human body Antibiotics and the growing problem of resistance Marine microbiology bacterial toxins and enzymes Bacterial genetics and genomics Bacteria that survive in extreme environments such as boiling water And much more This comprehensive guide features custom drawn black and white illustrations by artist Karoly Farkas and it illuminates its points through real world examples and engaging stories Discrete topic by topic

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Microbiology Perspectives George A. Wistreich, 2007 This photo atlas covers in a systematic way a wide range of microorganisms and their activities Students learn the characteristics of various types of microorganisms covered in introductory microbiology along with pertinent information about microorganism caused disease bacterial fungal protozoan viral helminthic Abundant exercises help students learn to observe and recognize fundamental similarities and differences among microorganisms

Study Guide for Microbiology with Diseases by Taxonomy Robert W. Bauman, Mindy Miller-Kittrell, Elizabeth Machunis-Masuoka, Laura Bonazzoli, 2010-01-21

Visualizing Microbiology Rodney P. Anderson, Linda Young, Kim R. Finer, 2020-12-16 The second edition of Visualizing Microbiology contains a completely redesigned TOC and the most current coverage of the COVID 19 pandemic This text is ideal for introductory microbiology courses for non majors and pre allied health students Visualizing Microbiology brings the narrative to life with an applied clinical focus helping students see and understand the unseen in the world of microbiology The unique visual pedagogy of the text provides a powerful combination of content and visuals ideal for microbiology

Patterns of Progress, 19??

Color Atlas of Medical Microbiology Charles Anthony Hart, Paul Shears, 2004 This compact color atlas is an ideal reference for the identification of medically important bacteria viruses fungi and parasites Over 460 superb full color photographs and electron micrographs with concise explanatory text and captions provide a clear framework for understanding and recognizing the pathogens that infect humans This 2nd Edition has been updated to include the latest information on molecular diagnostics as well as new and zoonotic pathogens It is invaluable both as a hands on clinical reference tool and as a self testing resource for exam review Offers more than 460 excellent full color electron micrographs and micrographs depicting microbiological samples Uses short clear captions and explanatory text to make important information easy to access in the laboratory setting Features a convenient pocket size perfect for benchside consultation or portable review Reflects the latest advances in our understanding of microbial pathogenesis such as the discovery of bacterial pathogenicity islands and Type III secretion systems that inject bacterial effectors directly into the host cell cytoplasm Describes many new emerging and re emerging infections and pathogens including SARS Presents expanded coverage of diagnostic bacteriology to include more automated and molecular diagnostic methods Includes a new discussion of biofilms and quorum sensing

Koneman's Color Atlas and Textbook of Diagnostic Microbiology Elmer W. Koneman, 2006 Long considered the definitive work in its field this new edition presents all the principles and practices readers need for a solid grounding in all aspects of clinical microbiology bacteriology mycology parasitology and virology Tests are presented according to the Clinical and Laboratory Standards Institute formerly NCCLS format This extensively

revised edition includes practical guidelines for cost effective clinically relevant evaluation of clinical specimens including extent of workup and abbreviated identification schemes New chapters cover the increasingly important areas of immunologic and molecular diagnosis Clinical correlations link microorganisms to specific disease states Over 600 color plates depict salient identification features of organisms

Illustrated Medical Microbiology Satish Gupte, Chandan Jyoti Das, Abhishek Gupta, 2008-11-01 A thoroughly revised and updated edition by using clear simple easy to understand well labeled and meaningful illustrations Includes about 20 25 new illustrations touching new topics of immense interest like SARS avian influenza H5 N1 etc All efforts are geared towards making the material more relevant to the requirements of the readers

Practical Atlas for Bacterial Identification D. Roy Cullimore, 2010-03-17 Published nearly ten years ago the first edition of Practical Atlas for Bacterial Identification broke new ground with the wealth of detail and breadth of information it provided The second edition is poised to do the same Differing fundamentally from the first edition this book begins by introducing the concept of bacteria community intelligent

Visual Mnemonics for Microbiology and Immunology Laurie L. Marbas, John W. Pelley, 2002 Visual Mnemonics for Microbiology and Immunology uses cartoon drawings that make material easier to learn with tremendous recall months later Laurie Marbas a third year medical student at Texas Tech University Health Sciences Center developed this series using concept diagramming to shorten her study time and help her recall the facts Classmates using these drawings reported improved test scores Students suggested she published her drawings to help other students Each page is formatted with plenty of space for notes and reminders and some students color the organisms for better recall Visual Mnemonics for Microbiology and Immunology includes sections on parasitology bacteriology mycology virology and immunology Perfect for medical students physician assistants nurse practitioners and related health professionals will also find Visual Mnemonics valuable

Bacteria Jeanne Kagle, 2024

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