وزارة التعليم العالي والبحث العلمي
الجامعة التقنية الجنوبية
المعهد التقني العمارة
قسم تقنيات المختبرات الطبية

الحقيبة التدريسية لمادة علم الأحياء المجهرية نظري

الصف: الثاني

تدريسي المادة

م.د. رواء صادق مجيد

الفصل الدراسي الأول

جدول مفردات مادة علم الأحياء المجهرية نظري

Theoretical syllabus	
Weeks	topics
1	Introduction to medical microbiology, Microorganism, instruction with the host, microbial virulence, historical significance
2	Classes of pathogenic microorganisms Viruses, bacteria, fungi, parasites
3	Classification and Scientific nomenclature of the bacteria. Normal Flora
4	Bacterial Structure
5	Bacterial division and growth
6	Bacterial Genetics, DNA transfer between bacteria
7	Pathogenicity of bacteria
8	TOXIGENESIS (bacterial toxin).
9	Classes of antibacterial agents
10	General characteristic and classification of virus
11	Viral genetics, a mutation, instruction between viruses, the role of genetic variation in evolution of viruses.
12	Pathogenicity of viruses
13	Classes of antiviral agents
14	Characteristic and classification of medical fungi.
15	Morphology and structure of fungi, Classes of antifungal agents

الهدف من دراسة مادة علم الأحياء المجهرية (الهدف العام):

تهدف دراسة مادة علم الأحياء المجهرية للصف الثاني إلى:

التعرف على الأحياء المجهرية التي تسبب الأمراض للإنسان وأمراضها وتشخيصها.

الفئة المستهدفة:

طلبة الصف الثاني/قسم تقنيات المختبرات الطبية.

التقنيات التربوية المستخدمة:

1- سبورة وأقلام.

2- السبورة التفاعلية.

3- عارض شاشة Data Show.

4- جهاز حاسوب محمول Laptop.

الأسبوع الأول

الهدف التعليمي: التعرف على الأحياء المجهرية الطبية وعلاقتها مع المضيف.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

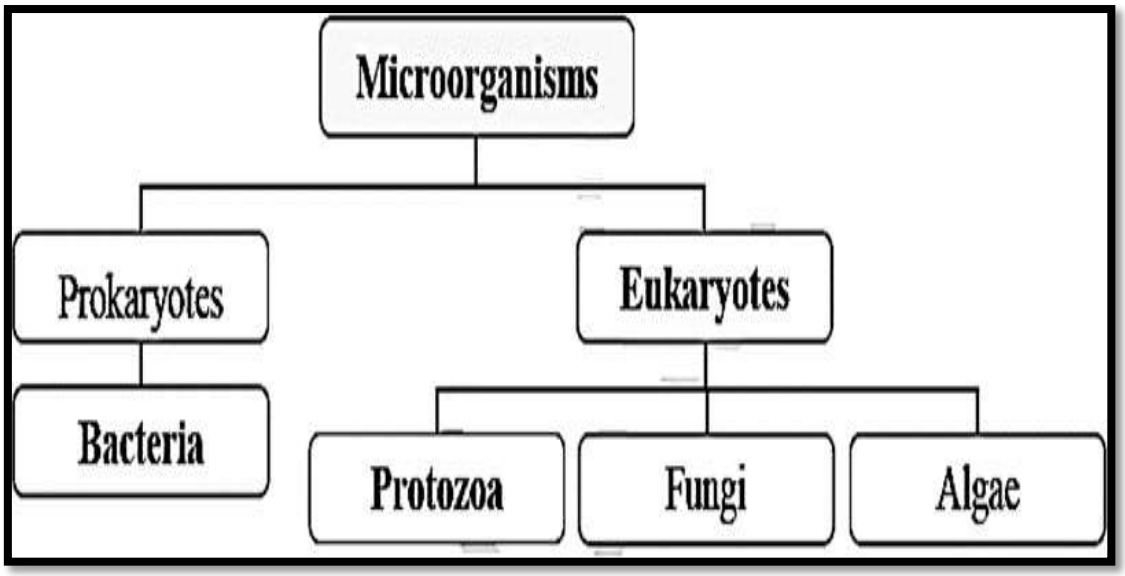
أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة **Introduction to Medical Microbiology**

Medical microbiology is a branch of microbiology that focuses on the study of microorganisms and their interactions with the human body, particularly in the context of health and disease. It plays a crucial role in understanding, diagnosing, and treating infectious diseases.

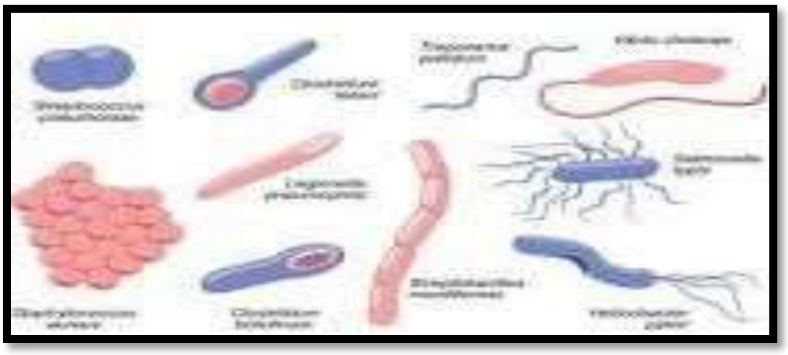
Microorganisms:

Microorganisms, also known as microbes, are tiny, living organisms that cannot be seen with the naked eye. They encompass a diverse group of life forms, including bacteria, viruses, fungi, and parasites. While many microbes are harmless and even beneficial to humans, some can cause diseases, making them the primary focus of medical microbiology.

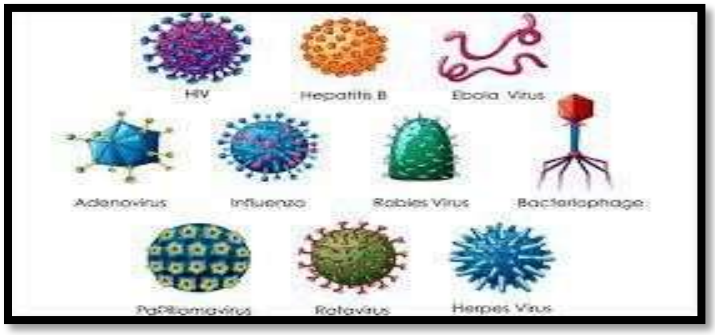


Microorganisms studied in medical microbiology include:

1- Bacteria: single-celled organisms that can be both beneficial (e.g., probiotic bacteria) and harmful (e.g., pathogenic bacteria causing infections).

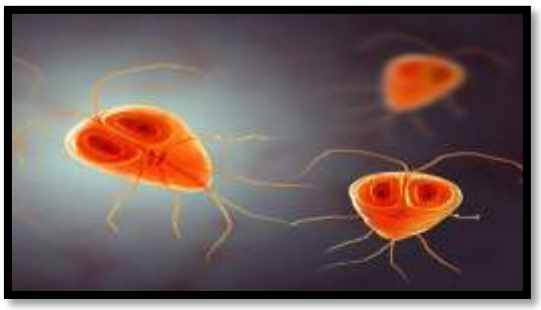


2- Viruses: submicroscopic infectious agents composed of genetic material (DNA or RNA) surrounded by a protein coat. They require host cells to replicate and can cause diseases like the common cold, flu, and HIV.



3- Fungi: microscopic fungi, such as Candida and Aspergillus, can cause fungal infections in humans, especially in individuals with weakened immune systems.

4- Parasites: Organisms like protozoa and helminths can infect humans and cause diseases such as malaria and intestinal infections.



Interaction with the Host:

Microorganisms interact with the host (the human body) in various ways, leading to either health or disease outcomes. These interactions are influenced by factors such as the microorganism's virulence and the host's immune system. Understanding these interactions is essential for diagnosing and treating infectious diseases. Key aspects of this interaction include:

1-Infection: the process by which microorganisms enter and establish themselves in the host's body.

2- Pathogenicity: the ability of a microorganism to cause disease in a host. This depends on factors like the microorganism's virulence and the host's immune response.

3- Immune Response: the host's defense mechanisms, including the immune system, play a critical role in defending against microbial invaders.

Microbial Virulence:

Microbial virulence refers to the degree or intensity of a microorganism's pathogenicity the ability to cause disease in a host. Virulence factors are specific characteristics possessed by some microorganisms that enhance their ability to cause disease. These factors can include toxins, adhesion molecules, and mechanisms for evading the host's immune system. Microbiologists study virulence factors to better understand how pathogens cause diseases and to develop strategies for preventing and treating infections.

Historical Significance:

The study of medical microbiology has a rich historical significance. Major milestones in the field include:

1- Discovery of Microorganisms: in the 17th century, Antonie van Leeuwenhoek's invention of the microscope allowed for the observation of microorganisms, opening the door to microbiology.

2- Germ Theory of Disease: in the 19th century, scientists like Louis Pasteur and Robert Koch established the germ theory of disease, linking specific microorganisms to various illnesses.

3- Development of Vaccines and Antibiotics: the discovery of vaccines (e.g., Edward Jenner's smallpox vaccine) and antibiotics (e.g., penicillin by Alexander Fleming) revolutionized the treatment and prevention of infectious diseases.

4- Modern Advances: advances in molecular biology and genetics have greatly expanded our understanding of microorganisms and their interactions with the host.

الأسبوع الثاني

الهدف التعليمي: التعرف على أصناف الأحياء المجهرية (فيروسات، بكتريا، فطريات، طفيليات).

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: Classes of pathogenic microorganisms viruses, bacteria, fungi, parasites

Pathogenic microorganisms can be classified into four main groups based on their biological characteristics and the types of diseases they cause:

1- Viruses:

- Viruses are submicroscopic infectious agents composed of genetic material (either DNA or RNA) surrounded by a protein coat.

- They cannot carry out metabolic processes on their own and must infect host cells to replicate.

- Viruses can cause a wide range of diseases in humans, including the common cold, influenza, HIV/AIDS, COVID-19, and many others.

- They are not classified as living organisms because they lack cellular structure and independent metabolic functions.

2- Bacteria:

- Bacteria are single-celled, prokaryotic microorganisms with a variety of shapes and sizes.

- Some bacteria are pathogenic and can cause infections and diseases in humans, such as tuberculosis, strep throat, urinary tract infections, and foodborne illnesses.

- Bacteria can be classified based on their staining characteristics into Gram-positive and Gram-negative bacteria.

3- Fungi:

- Fungi are eukaryotic microorganisms that include yeasts, molds, and mushrooms.

- Some fungi can be pathogenic to humans, causing fungal infections. Common examples include Candida (causing yeast infections) , Aspergillus (causing lung infections) , and dermatophytes (causing skin infections like ringworm).

- Fungal infections can affect various parts of the body , including the skin , nails , respiratory tract, and internal organs.

4- Parasites:

- Parasites are organisms that live on or within a host organism and derive nutrients at the host's expense.

- They include protozoa (single-celled organisms) and helminths (worms).

- Parasitic infections can lead to diseases such as malaria (caused by Plasmodium protozoa), intestinal worm infections (e.g., hookworm), and various other tropical diseases.

الأسبوع الثالث

الهدف التعليمي: التعرف على تصنيف البكتريا والتسمية العلمية الثنائية.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: Classification and Scientific nomenclature of the bacteria

Bacteria are classified based on various characteristics, including their shape, size, staining properties, metabolic processes, and genetic makeup. The scientific nomenclature of bacteria follows a standardized system known as nomenclature, which assigns each bacterium a two-part scientific name.

Classification of Bacteria:

Bacteria are classified into several categories, which include:

1- Domain: bacteria belong to the domain Bacteria,

2- Phylum: bacteria are further divided into phyla based on their genetic and structural characteristics.

3- Class: Each phylum is further divided into classes based on more specific characteristics.

4- Order: Within each class, bacteria are grouped into orders. For example, the order Lactobacillales includes bacteria like Lactobacillus species.

5- Family: Bacteria within an order are further categorized into families. For instance, the family Enterobacteriaceae includes bacteria like Escherichia coli and Salmonella.

6- Genus: Each family contains one or more genera, which group together closely related species based on shared characteristics. For example, the genus Staphylococcus includes species like Staphylococcus aureus and Staphylococcus epidermidis.

7- Species: The most specific level of classification is the species. The species name is typically written in lowercase and italicized (or underlined) and follows the genus name. For example, Staphylococcus aureus is the species name for a specific type of staphylococcus bacterium.

Scientific Nomenclature:

The scientific nomenclature for bacteria follows a binomial system, where each bacterium is given a two-part name consisting of the genus and species names. These names are often written in italics (or underlined) and are sometimes abbreviated with the initial letter of the genus followed by the species name. For example:

Escherichia coli (or *E. coli*): Genus name (Escherichia) followed by species name (coli).

Normal flora:

Normal flora, also known as the microbiota , refers to the diverse population of microorganisms, including bacteria, that naturally reside in and on the human body. These microorganisms are typically harmless or even beneficial and play important roles in maintaining health. They can be found in various body sites, including the skin, mouth, gut, and reproductive organs.

While most normal flora bacteria are commensal (they coexist without causing harm), some can become opportunistic pathogens under certain conditions, causing infections when the host's immune system is compromised.

الأسبوع الرابع

الهدف التعليمي: التعرف على تركيب البكتريا:

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Bacterial Structure**

Bacteria are single-celled microorganisms with relatively simple but highly specialized structures. Their structural components play crucial roles in their function, survival, and interactions with their environment. Here is an overview of the main components of bacterial structure:

1- Cell Wall:

- The cell wall is a rigid outer layer that surrounds the bacterial cell membrane. It provides structural support and protection against osmotic pressure changes.

- In Gram-positive bacteria, the cell wall is thick and composed primarily of a thick layer of peptidoglycan, a complex molecule made up of sugars and amino acids.

- In Gram-negative bacteria , the cell wall is thinner and consists of a thinner layer of peptidoglycan covered by an outer membrane containing lipopolysaccharides (LPS).

2- Cell Membrane (Plasma Membrane):

- The cell membrane is a lipid bilayer that surrounds the cytoplasm of the bacterial cell. It regulates the passage of substances in and out of the cell.

- It contains proteins that are essential for various cellular processes, including transport of nutrients, energy production, and cell signaling.

3- Cytoplasm:

- The cytoplasm is the gel-like substance enclosed by the cell membrane. It contains various cellular structures, including ribosomes and the bacterial chromosome.

- Many metabolic reactions take place within the cytoplasm , including the synthesis of proteins and the generation of energy through processes like glycolysis.

4- Ribosomes:

- Ribosomes are small structures in the cytoplasm that are responsible for protein synthesis. Bacterial ribosomes are smaller than eukaryotic ribosomes.

- They read the genetic code from the bacterial chromosome and assemble amino acids into proteins.

5- Bacterial Chromosome (Nucleoid):

- Bacterial DNA is typically a single , circular molecule located in the nucleoid region , which is not membrane-bound.

- It contains the genetic information necessary for the bacterial cell's growth, replication , and function.

6- Plasmids:

- Plasmids are small , circular pieces of DNA that can be found in some bacterial cells in addition to the main chromosome.

They often carry genes that provide advantages such as antibiotic resistance or the ability to metabolize specific nutrients.

7- Capsule and Slime Layer:

- Some bacteria have an outer capsule or slime layer, which is a protective and often sticky layer surrounding the cell wall.

- This layer can help bacteria evade the host's immune system or adhere to surfaces.

8- Flagella:

- Flagella are long , whip-like structures that some bacteria use for locomotion. They rotate to propel the bacterium through liquid environments.

- The presence, number, and arrangement of flagella can vary among bacterial species.

9- Pili and Fimbriae:

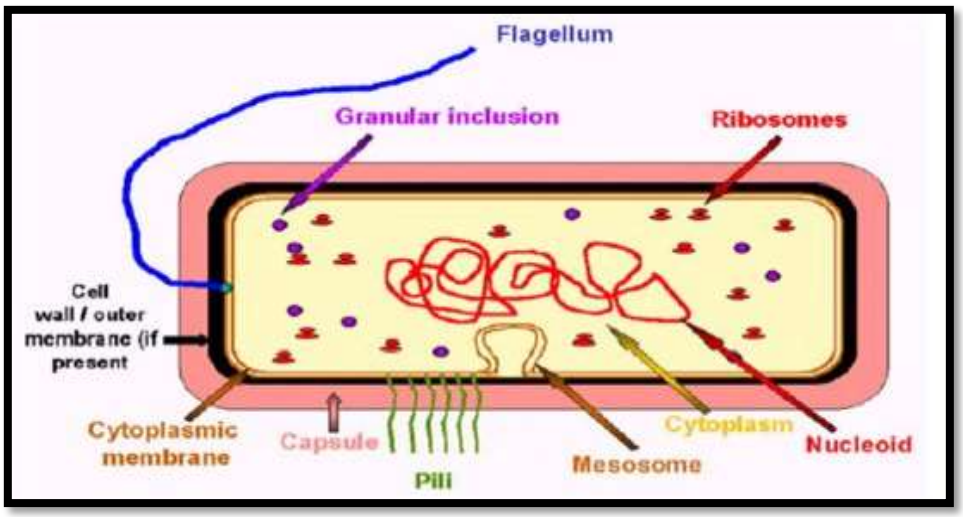
- Pili and fimbriae are hair-like appendages that extend from the bacterial surface.

- They can serve various functions, including attachment to host cells or other surfaces and the transfer of genetic material (conjugation).

10- Endospores:

- Endospores are highly resistant, dormant structures formed by some bacteria when they encounter unfavorable conditions.

- They protect the bacterial DNA and allow the bacterium to survive harsh environments.



الأسبوع الخامس

الهدف التعليمي: التعرف على انقسام ونمو البكتريا.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Bacterial division and growth**

Bacterial division and growth are fundamental processes in the life cycle of bacteria. These processes are critical for increasing the bacterial population and play a key role in various fields, including microbiology, medicine, and biotechnology. Here's an overview of bacterial division and growth:

Bacterial Division:

Bacterial division is the process by which a single bacterial cell divides into two daughter cells. This process allows bacteria to reproduce asexually, resulting in exponential growth under favorable conditions. The primary steps in bacterial division are:

1- Replication of DNA: before division, the bacterial cell replicates its single circular chromosome. This replication begins at the origin of replication and proceeds in both directions around the chromosome.

2- Septum Formation: a septum (cell wall and cell membrane) begins to form at the midpoint of the cell, dividing it into two compartments.

3- Cell Wall Synthesis: new cell wall material is synthesized and deposited along the septum. In gram-negative bacteria, this process involves the formation of a peptidoglycan layer, while in gram-positive bacteria, a thick layer of peptidoglycan is deposited.

4- Division Completion: as the septum is completed, the two daughter cells become physically separated. Each daughter cell contains a copy of the original chromosome and other cellular components.

5- Cytokinesis: the final step involves the separation of the two daughter cells, resulting in two genetically identical bacterial cells.

Bacterial Growth:

Bacterial growth refers to the increase in the number of bacterial cells in a population. Bacterial growth can be divided into several phases:

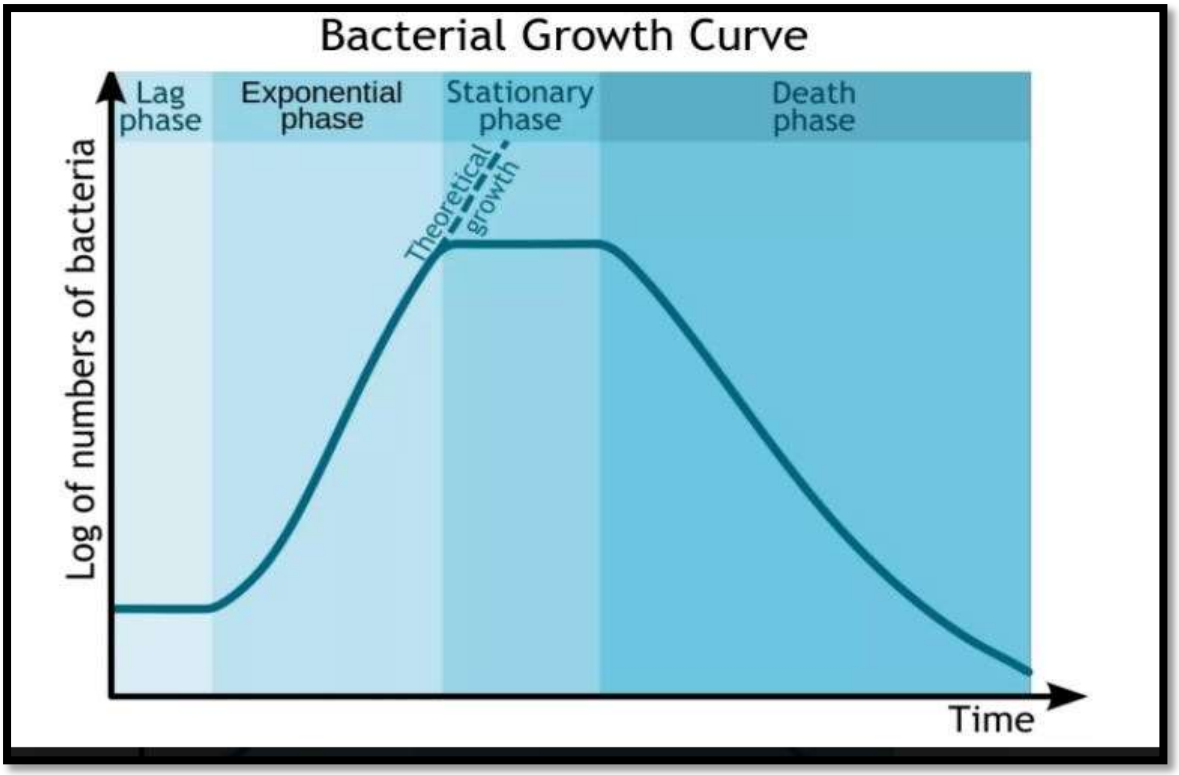
1- Lag Phase: in this initial phase, bacteria adapt to their environment, synthesize essential enzymes, and prepare for rapid growth. Cell numbers do not increase significantly during this phase.

2- Logarithmic (Exponential) Phase: during this phase, bacterial growth is characterized by exponential population growth. Bacteria divide rapidly and double in number with each generation as long as the environment remains favorable. This phase is ideal for studying bacterial physiology and for industrial applications like fermentation.

3- Stationary Phase: in the stationary phase, the growth rate of bacteria slows down, and the number of cells entering division equals the number of cells exiting division. This phase occurs when resources become limited or waste products accumulate.

4- Death Phase: in the death phase, the number of viable bacterial cells starts to decline. This phase is characterized by cell death and a decrease in the overall population.

Bacterial growth is influenced by various factors, including nutrient availability, temperature, pH, oxygen levels, and the presence of inhibitors or antimicrobial agents. Bacterial growth curves can be plotted to visualize the different phases of growth over time.


Bacterial Growth Curve
Lag phase
Exponential phase
Stationary phase
Death phase
Theoretical growth
Log of numbers of bacteria
Time

الأسبوع السادس

الهدف التعليمي: التعرف على وراثة البكتريا ونقل الحامض النووي DNA.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Bacterial Genetics, DNA transfer between bacteria**

Bacterial genetics is the study of how genetic information is stored, replicated, and transmitted within bacterial cells. Bacteria possess a single, circular chromosome that contains their genetic material. Additionally, they may carry small, circular pieces of DNA called plasmids, which can play a significant role in bacterial genetics. DNA transfer between bacteria is a fundamental process that contributes to genetic diversity, antibiotic resistance, and the spread of virulence factors. There are several mechanisms by which DNA can be transferred between bacteria:

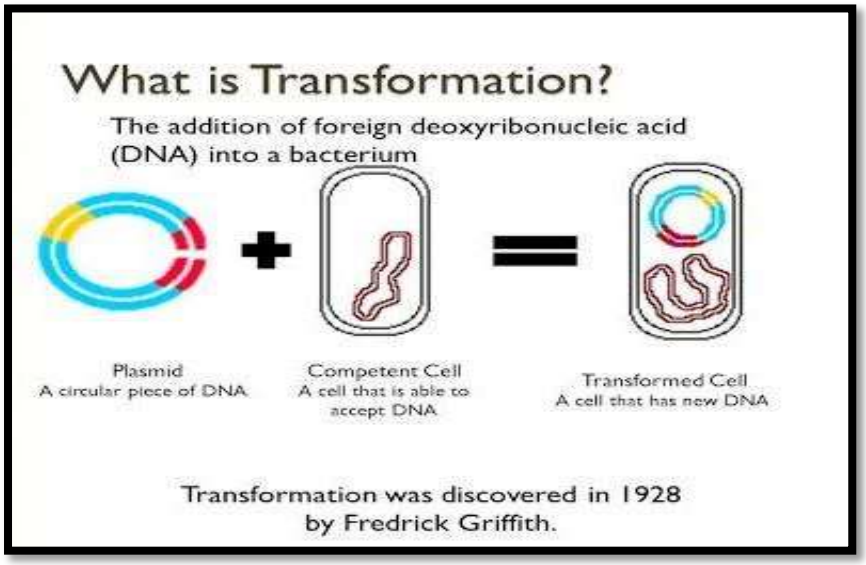
1- Transformation:

- Transformation is the process by which bacteria take up DNA from their environment and incorporate it into their genome.

- This process can occur naturally or be induced in the laboratory.

- The transferred DNA is typically in the form of short, single- stranded fragments called DNA fragments or plasmids.

- Not all bacteria are naturally competent for transformation, but some can be made competent by subjecting them to specific laboratory conditions.



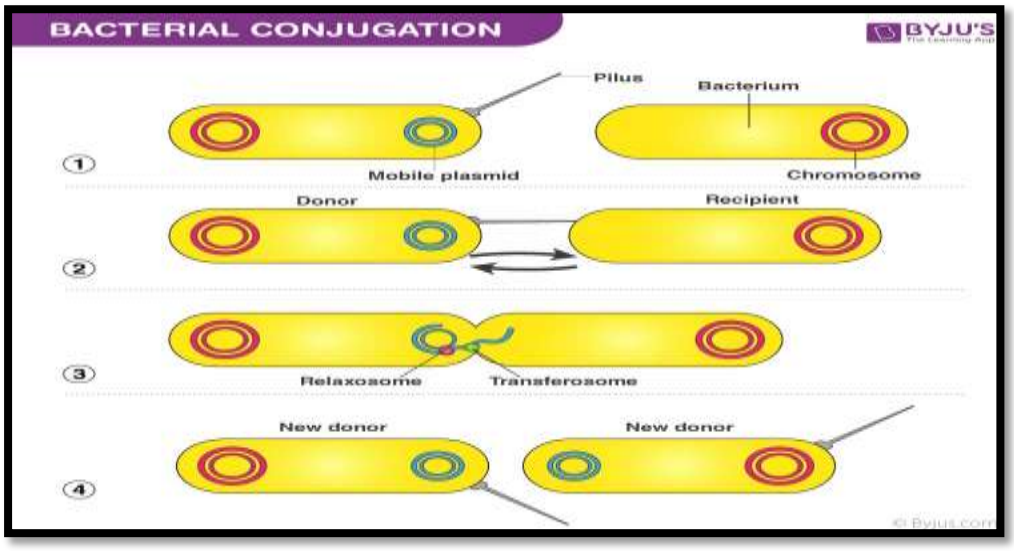
2- Conjugation:

- Conjugation is a mechanism of genetic transfer in which one bacterium directly transfers DNA to another bacterium through a physical bridge called a pilus.

- The donor bacterium contains a plasmid (conjugative plasmid) that carries the genes necessary for conjugation.

- During conjugation, a copy of the plasmid is transferred from the donor to the recipient, leading to the acquisition of new genetic material by the recipient.

- Conjugation can transfer plasmids carrying antibiotic resistance genes and virulence factors.

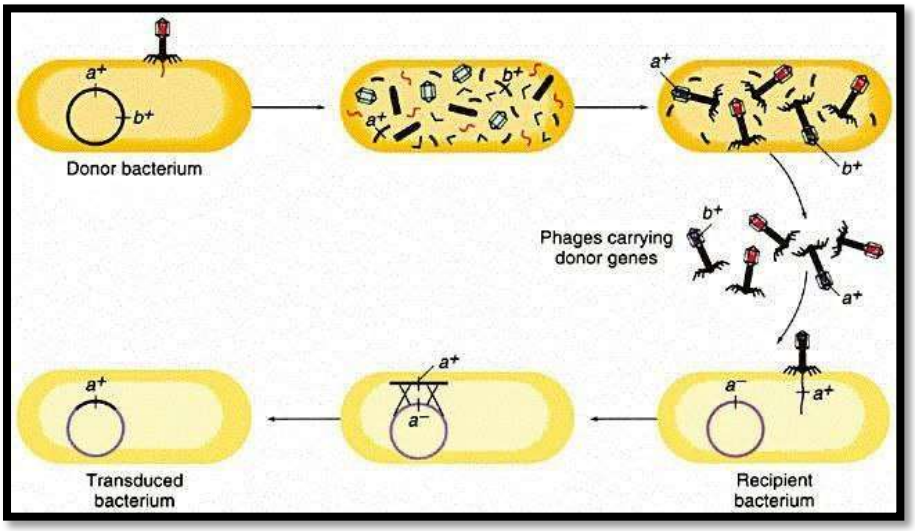


3- Transduction:

- Transduction is a process in which bacterial DNA is transferred from one bacterium to another by a bacteriophage (a virus that infects bacteria).

- When a bacteriophage infects a bacterial cell, it can accidentally package bacterial DNA into its capsid instead of its own genetic material.

- The bacteriophage then infects another bacterium and injects this bacterial DNA, which can integrate into the recipient's chromosome or exist as a plasmid.



الأسبوع السابع

الهدف التعليمي: التعرف على إمراضية البكتريا.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Pathogenicity of bacteria**

Pathogenicity is the ability of bacteria to cause disease in a host organism. Bacteria that possess pathogenicity have evolved various mechanisms to overcome host defenses, colonize host tissues, and induce disease. mechanisms that contribute to the pathogenicity of bacteria:

1- Adherence and Colonization: Pathogenic bacteria often have adhesins or surface structures that allow them to adhere to host cells or tissues.. For example, *Escherichia coli* (*E.* coli) possesses fimbriae that aid in adherence to intestinal cells.

2- Invasion: Some pathogenic bacteria can invade host tissues after adhering to the host's cells. They may use various mechanisms, such as secretion systems or the ability to induce host cell endocytosis. Examples include Salmonella, which invades intestinal cells, and *Streptococcus pneumoniae*, which invades lung tissue.

3- Evasion of Host Immune Responses: Pathogenic bacteria have evolved strategies to evade the host immune system.

4- Toxin Production: Many pathogenic bacteria produce toxins that damage host cells and tissues. Toxins can be categorized as exotoxins (secreted by bacteria) or endotoxins (part of the bacterial cell wall, released upon bacterial death).

5- Immune Evasion and Antigenic Variation: Some bacteria can change their surface antigens, making it difficult for the host immune system to recognize and mount an effective defense. This antigenic variation helps bacteria evade host antibodies.

6- Biofilm Formation: Bacteria can form biofilms, which are communities of bacteria encased in a protective matrix of extracellular polymeric substances. Biofilms allow bacteria to persist in host tissues and resist immune responses and antibiotics. Pseudomonas aeruginosa is known for its biofilm-forming ability in chronic lung infections.

7- Host Tissue Damage: Pathogenic bacteria can cause damage to host tissues directly through toxins

8- Nutrient Acquisition: Some pathogenic bacteria have specialized mechanisms for acquiring nutrients from the host, such as gate iron from host proteins. This enhances bacterial survival and replication.

9-Antibiotic Resistance: Pathogenic bacteria can develop antibiotic resistance through genetic mutations or acquisition of resistance genes. This resistance can make infections difficult to treat and increase the severity of diseases.

الأسبوع الثامن

الهدف التعليمي: التعرف على سمية البكتريا.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Toxigenesis (Bacterial Toxin)**

Toxigenesis refers to the process by which bacteria produce toxins. Bacterial toxins are molecules that can be harmful to host organisms, including humans, by disrupting normal cellular functions and leading to disease symptoms. Bacterial toxins are a major virulence factor for many pathogenic bacteria and play a crucial role in the development of bacterial diseases.

Types of Bacterial Toxins:

1- Exotoxins: these are proteins produced and secreted by living bacterial cells into the surrounding environment. Exotoxins can be highly potent and have specific effects on host cells. They are typically heat-labile and can be neutralized by antibodies. Examples of bacteria producing exotoxins include *Clostridium tetani* (causing tetanus) and *Corynebacterium diphtheriae* (causing diphtheria).

2- Endotoxins: are lipopolysaccharides (LPS) located in the outer membrane of Gram-negative bacteria. They are released when the bacterial cell dies or is lysed.

Mechanisms of Toxigenesis:

The mechanisms by which bacteria produce toxins can vary, but some common pathways and processes involved in toxigenesis include:

1- Gene Expression: bacteria possess specific genes that code for toxin production. These genes are typically found on plasmids (e.g., the diphtheria toxin gene) or within the bacterial chromosome (e.g., the cholera toxin gene in *Vibrio cholerae*).

2- Toxin Secretion: in the case of exotoxins, bacteria produce these toxins intracellularly and then secrete them into the extracellular environment. The secretion systems involved can vary depending on the bacterial species.

3- Toxin Activation: some bacterial toxins are produced as inactive pro- toxins (also known as zymogens) and require activation. Activation can occur through proteolytic cleavage or other mechanisms. For example, botulinum neurotoxin is produced as an inactive pro-toxin and must be cleaved to become active.

4- Host Cell Binding: exotoxins often have specific binding domains that allow them to attach to host cell receptors.

5- Cellular Damage: once inside the host cell or bloodstream, bacterial toxins exert their effects, which can include disrupting cellular functions, inhibiting protein synthesis, affecting on cell membrane

6- Systemic Effects: bacterial toxins can have both localized and systemic effects, depending on their properties and the specific tissues or organs they target. For example, Shiga toxin produced by *E. coli* can cause systemic effects, including kidney damage.

Clinical Implications:

Bacterial toxins are major contributors to the pathogenesis of various bacterial infections. Diseases caused by bacterial toxins can manifest as food poisoning, respiratory diseases, gastrointestinal infections, and more.

الأسبوع التاسع

الهدف التعليمي: التعرف على أصناف العوامل المضادة للبكتريا.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Classes of antibacterial agents**

Antibacterial agents are substances or medications that are used to inhibit or kill bacteria, thereby treating or preventing bacterial infections. These agents can be categorized into several classes based on their mechanism of action, chemical structure, and target bacteria. Here are some of the main classes of antibacterial agents:

Antibiotics:

- Antibiotics are natural or synthetic compounds produced by microorganisms or chemically synthesized in the laboratory.

- They work by interfering with specific bacterial processes or structures, such as cell wall synthesis, protein synthesis, DNA replication, or metabolic pathways.

- Common classes of antibiotics include penicillins, cephalosporins, macrolides, tetracyclines, aminoglycosides, and fluoroquinolones.

2- Antibacterial Peptides:

- These are short peptides with antibacterial properties that can disrupt bacterial cell membranes, leading to cell lysis.

- Examples include polymyxins and colistin.

3- Sulfonamides (Sulfa Drugs):

- Sulfonamides are synthetic antimicrobial agents that inhibit the synthesis of folic acid, which is essential for bacterial growth.

- Trimethoprim-sulfamethoxazole (TMP-SMX) is a commonly used combination of sulfonamide and another antibacterial agent.

4- Quinolones and Fluoroquinolones:

- These synthetic compounds target bacterial DNA gyrase and topoisomerase IV, enzymes involved in DNA replication and repair.

- Ciprofloxacin and levofloxacin are examples of fluoroquinolones.

5- Antibacterial Agents Targeting Cell Wall Synthesis:

- These agents disrupt the synthesis of the bacterial cell wall, leading to cell lysis.

- Examples include penicillins, cephalosporins, and vancomycin.

6- Antibacterial Agents Targeting Protein Synthesis:

- Antibiotics in this class inhibit bacterial protein synthesis by binding to ribosomal subunits.

- Classes include aminoglycosides (e.g., gentamicin), macrolides (e.g., erythromycin), and tetracyclines (e.g., doxycycline).

7- Antibacterial Agents Targeting DNA Synthesis and Replication:

- Some antibacterials interfere with bacterial DNA replication or repair mechanisms.

- Examples include metronidazole and fluoroquinolones.

8- Antibacterial Agents Targeting Metabolic Pathways:

- These agents disrupt specific metabolic pathways essential for bacterial growth and survival.

- Trimethoprim targets the folate synthesis pathway, while sulfa drugs inhibit dihydropteroate synthase.

9- Antibacterial Agents Targeting RNA Polymerase:

Rifampin is an example of an antibiotic that inhibits bacterial RNA polymerase, interfering with RNA synthesis.

10- Antibacterial Combinations:

Some treatments involve using a combination of antibacterial agents to increase efficacy or prevent resistance. For example, amoxicillin-clavulanic acid combines a penicillin (amoxicillin) with a beta-lactamase inhibitor (clavulanic acid).

11- Antiseptics and Disinfectants:

- These agents are used for topical application or environmental disinfection rather than systemic treatment.

- Examples include alcohol-based hand sanitizers, iodine-based antiseptics, and bleach.

الأسبوع العاشر

الهدف التعليمي: التعرف على صفات وتصنيف الفيروسات.

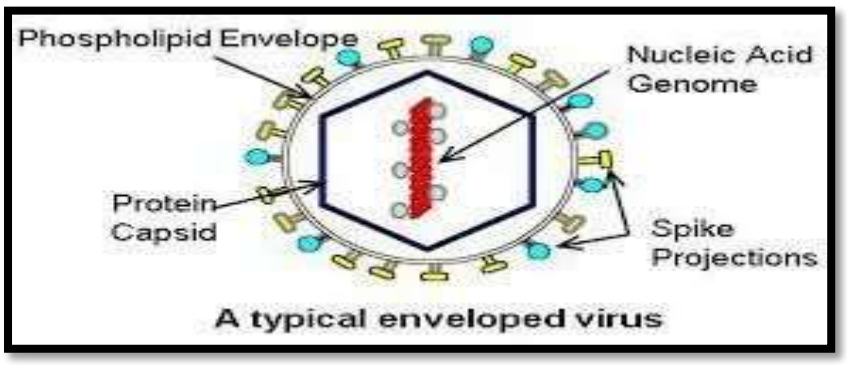
مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **General characteristic and classification of virus**

Viruses are unique and fascinating infectious agents that occupy a unique position in the biological world. They are not considered living organisms in the traditional sense because they cannot carry out metabolic processes, grow, or reproduce independently. Instead, they are obligate intracellular parasites, relying on host cells to replicate and multiply. Here are the general characteristics and classification of viruses:



General Characteristics of Viruses:

1. **Non-Cellular:** viruses are acellular, meaning they do not have a cellular structure like bacteria, fungi, or plants. Instead, they consist of genetic material (either DNA or RNA) surrounded by a protein coat called a capsid.
2. **Genetic Material:** viruses can have either DNA or RNA as their genetic material. Some viruses have double-stranded DNA (dsDNA), single- stranded DNA (ssDNA), double-stranded RNA (dsRNA), or single- stranded RNA (ssRNA).

3. **Capsid:** the capsid is a protein shell that encases and protects the viral genetic material. It is composed of protein subunits called capsomers.
4. **Lack of Metabolism:** viruses lack the cellular machinery required for metabolic processes, including energy production and protein synthesis. They depend on host cell machinery for these functions.
5. **Host Specificity:** viruses are highly host-specific. Each virus can infect a specific type of host cell or a narrow range of host species due to specific interactions between viral proteins and host receptors.
6. **Obligate Intracellular Parasites:** viruses cannot replicate or reproduce outside of a host cell. They must infect a host cell to reproduce and multiply.
7. **Variability:** viruses exhibit high genetic variability due to the error- prone nature of their replication. This genetic diversity can lead to the emergence of new strains and the ability to adapt to changing environments.

Classification of Viruses:

Viruses are classified based on several criteria, including their genetic material, capsid structure, and life cycle. The main taxonomic ranks for virus classification are:

1. **Family:** viruses are grouped into families based on common features such as genetic structure, replication strategy, and morphology. Families are identified by names ending in "-viridae." Examples include the Herpesviridae family and the Retroviridae family.
2. **Genus:** each family is further divided into genera (plural of genus). Virus genera share even more specific characteristics. Genera names end in "- virus." For example, within the Herpesviridae family, there are different genera like Varicellovirus and Simplexvirus.
3. **Species:** each virus species is identified based on specific criteria, including genetic divergence, host range, and disease characteristics. Species names often include the name of the host or disease. For example, Human Herpesvirus 1 (HHV-1) is commonly known as herpes simplex virus type 1 (HSV-1).

4. **Strain and Serotype:** within a species, viruses can be further classified into strains based on genetic variations or serotypes based on antigenic differences. These distinctions are important for tracking and managing diseases.

الأسبوع الحادي عشر

الهدف التعليمي: التعرف على وراثة الفيروسات.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة:

Viral genetics, a mutation, instruction between viruses, the role of genetic variation in evolution of viruses.

Viral genetics is the study of the genetic material and genetic processes of viruses. Viruses have a simple genetic structure compared to living organisms, consisting of either DNA or RNA enclosed in a protein coat.

Mutation in Viral Genetics:

- Viruses are highly prone to mutations due to the error-prone nature of their replication machinery. As they replicate inside host cells, errors can occur during DNA or RNA synthesis, resulting in genetic changes.
- Mutations in viral genomes can lead to variations in the viral population, creating a pool of genetically diverse viruses.
- Some mutations are neutral and have no effect on viral fitness, while others can be detrimental or beneficial, affecting the virus's ability to infect, replicate, or evade host defenses.
- Accumulated mutations over time can drive viral evolution, potentially leading to the emergence of new strains or variants with altered properties.

2. **Interactions Between Viruses:**

- Viruses can interact with each other in various ways, including competition and cooperation.

- Competition occurs when multiple viral strains or species compete for the same host resources. This can lead to the dominance of one strain over others.
- Cooperation between different viruses can involve genetic reassortment (exchange of genetic material) or recombination, resulting in new hybrid viruses.
- In some cases, cooperation between viruses can enhance their infectivity or virulence, potentially increasing the severity of diseases.

3. **Role of Genetic Variation in Viral Evolution:**
    - Genetic variation is a driving force behind viral evolution. It allows viruses to adapt to changing environments and host immune responses.
    - Genetic variation can result from mutations, recombination, reassortment, and horizontal gene transfer.
    - Viral evolution is shaped by selective pressures, such as host immune defenses and antiviral treatments. Viruses that can evade these pressures through genetic changes are more likely to persist and spread.
    - In the context of RNA viruses like HIV and influenza, rapid mutation rates and high genetic diversity make them difficult to control with vaccines or antiviral drugs.
4. **Epidemics and Pandemics:**
    - Genetic variation plays a critical role in the emergence of viral epidemics and pandemics. New viral strains with increased transmissibility, virulence, or resistance to treatments can lead to widespread outbreaks.
    - Examples include the emergence of novel influenza strains (e.g., H1N1, H5N1) and the rapid evolution of SARS-CoV-2, the virus responsible for COVID-19.

الأسبوع الثاني عشر

الهدف التعليمي: التعرف على إمراضية الفيروسات.

مدة المحاضرة: ساعاتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Pathogenicity of Viruses**

The pathogenicity of viruses refers to their ability to cause disease in a host organism. Viruses are obligate intracellular parasites, meaning they rely on host cells to replicate and reproduce. When viruses infect host cells, they can disrupt normal cellular functions, cause tissue damage, and trigger immune responses, leading to a wide range of diseases.

Mechanism of infection:

There must be sufficient virus available to initiate the infection. Cells at the site of infection must be accessible, susceptible, and allow the virus to enter, and the host anti-viral defense systems must be ineffective or absent. There are several mechanisms that must occur for a viral disease to develop including:

1- Implantation: the virus must implant at the entry portal into the body. Viruses usually implant on cells of respiratory, gastrointestinal, skin and genital tissues.

2- Replication: the invading virus must reproduce itself in large numbers. It usually does this intracellularly.

3- Dispersal: the replicated viruses must spread to target organs (disease sites) throughout the body. The most common route of spread from the portal of entry is the circulatory system, which the virus reaches via the lymphatic system. Viruses can access target organs

from the blood capillaries by multiplying inside endothelial cells, moving through gaps, or by being carried inside the organ on leukocytes. Some viruses, such as Herpes, rabies and polio viruses, can also disseminate via nerves.

4- Shedding: the viruses must spread to sites where shedding into the environment can occur. The respiratory, alimentary and urogenital tracts and the blood are the most frequent sites of shedding.

Not all infections lead to new progeny virus. Productive infections occur in permissive cells and result in the production of infectious virus. Abortive infections fail to produce infectious progeny, either because the cell may be non-permissive and unable to support the expression of all viral genes or because the infecting virus may be defective, lacking some functional viral gene. A latent infection may ensue with the persistence of viral genome, the expression of no or few viral genes and the survival of infected cell. So, the pattern of replication may vary for a given virus, depending on the types of host cell infected.

The Target Organs of Viral Infection:

1- Skin**:** a rash is features in number of viral infections like hemorrhagic rash, macula-popular rash like Meseals or purpuric rash**.**

2- Lung: most respiratory infection involved as a part of generalized infection like Meseals.

3- Liver: Target of hepatitis viruses (A,B,C,D,E) also may be damaged as a part of generalized infection

4- Central nervous system: like Rabies.

5- Blood stream: virus cause viremia like polio virus

6- Nervous system: like VZV and Rabies.

7- Kidney: like CMV shed in to the urine.

الأسبوع الثالث عشر

الهدف التعليمي: التعرف على العوامل المضادة للفيروسات.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Classes of antiviral agents**

Antiviral agents are medications or compounds designed to inhibit the replication and spread of viruses in the body. These agents can target various stages of the viral life cycle or interfere with specific viral components. Antiviral drugs are classified into several categories based on their mechanisms of action. Here are some of the main classes of antiviral agents:

1. **Nucleoside/Nucleotide Analog Reverse Transcriptase Inhibitors (NRTIs and NtRTIs):**
    - These drugs target retroviruses like HIV.
    - Examples include zidovudine (AZT), tenofovir, and lamivudine.
2. **Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs):**
    - NNRTIs inhibit reverse transcriptase, an enzyme essential for HIV replication, by binding to it and disrupting its function.
    - Examples include efavirenz and nevirapine.
3. **Protease Inhibitors (PIs):**
    - Protease inhibitors interfere with the activity of viral proteases, enzymes necessary for the processing of viral polyproteins into functional viral proteins.
    - Examples include ritonavir, atazanavir, and darunavir.
4. **Integrase Strand Transfer Inhibitors (INSTIs):**
    - INSTIs block the action of integrase, an enzyme that HIV uses to integrate its genetic material into the host cell's DNA.

- Examples include raltegravir and dolutegravir.

5. **Fusion Inhibitors:**
    - Fusion inhibitors prevent the fusion of viral and host cell membranes, preventing the virus from entering the host cell.
    - Enfuvirtide is an example used in HIV treatment.
6. **Neuraminidase Inhibitors:**
    - These drugs target the neuraminidase enzyme of influenza viruses, preventing the release of newly formed virus particles from infected cells.
    - Examples include oseltamivir (Tamiflu) and zanamivir (Relenza).
7. **Polymerase Inhibitors:**
    - Polymerase inhibitors can target various viral polymerases, including RNA polymerases and DNA polymerases.
    - Sofosbuvir, for example, is used to treat hepatitis C by inhibiting the virus's RNA polymerase.
8. **Antiretroviral Combination Therapy:**
    - Many antiretroviral treatments for HIV combine drugs from different classes to increase efficacy and reduce the risk of drug resistance.
    - Highly Active Antiretroviral Therapy (HAART) is a prime example of this approach.
9. **Broad-Spectrum Antivirals:**
    - Some antivirals, such as ribavirin and remdesivir, have broad- spectrum activity against a range of viruses. Ribavirin is used to treat hepatitis C, while remdesivir has been authorized for the treatment of COVID-19.
10. **Immunomodulators:**
    - These agents modulate the host's immune response to viral infections.

- Interferons, for example, are proteins that can enhance the immune system's ability to combat certain viruses.

11. **Vaccines:**

- Vaccines are preventive antiviral measures that stimulate the host's immune system to produce protective antibodies against specific viruses. They do not treat existing infections but prevent future ones.
- COVID-19 vaccines, such as those based on mRNA technology, are notable examples.

الأسبوع الرابع عشر

الهدف التعليمي: التعرف على صفات وتصنيف الفطريات الطبية.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة: **Characteristic and classification of medical fungi**

Medical fungi are a group of fungi that have clinical significance because they can cause fungal infections in humans. These infections, known as mycoses, can vary in severity from superficial skin infections to life-threatening systemic diseases. Medical fungi are classified based on their characteristics and the types of infections they cause. Here are the key characteristics and classifications of medical fungi:

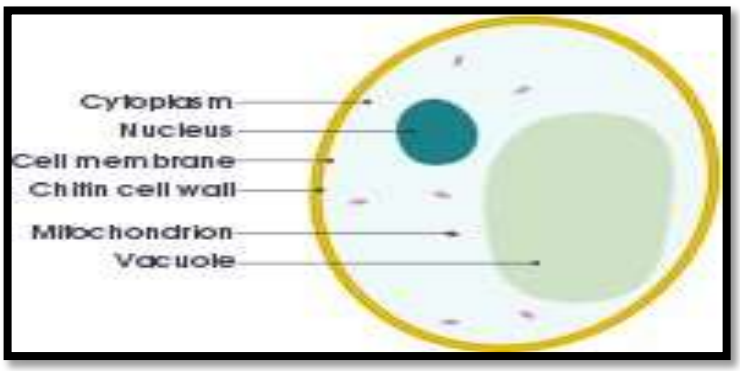
Characteristics of Medical Fungi:

1. **Eukaryotic:** medical fungi, like all fungi, are eukaryotic organisms. They have a well-defined nucleus and membrane-bound organelles.
2. **Heterotrophic:** fungi are heterotrophic, meaning they obtain nutrients by absorbing organic matter from their environment. They are unable to perform photosynthesis.
3. **Cell Wall:** fungal cells have a rigid cell wall primarily composed of a complex sugar called chitin. This distinguishes them from human cells, which lack chitin.
4. **Growth Form:** medical fungi can exist in various growth forms, including yeasts (unicellular), molds (multicellular with filamentous structures), and dimorphic fungi (capable of existing as both yeasts and molds).
5. **Reproduction:** fungi can reproduce both sexually and asexually. Asexual reproduction often involves the formation of spores, which can be airborne and contribute to fungal spread.
6. **Morphology:** fungal colonies can exhibit diverse morphologies, including color, texture, and shape, depending on the species and the environmental conditions.

Classification of Medical Fungi:

Medical fungi are classified into several groups based on their characteristics and the types of diseases they cause. The main classes include:

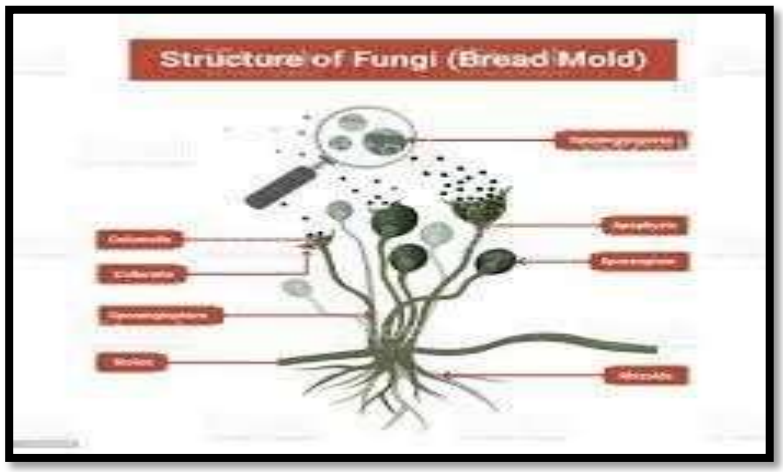
1. **Yeasts:** are unicellular fungi that reproduce by budding. Some medically important yeasts include:



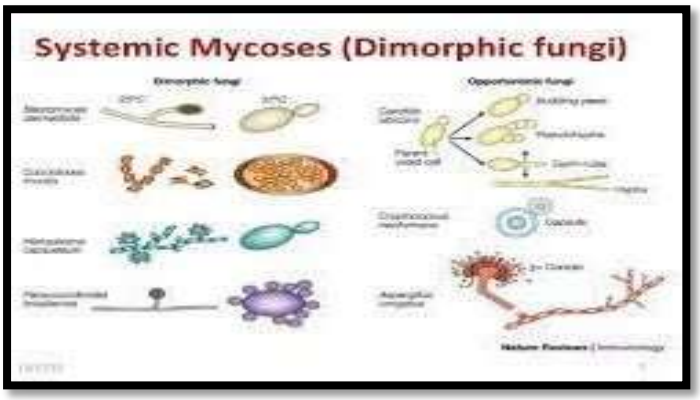
- *Candida* spp.: commonly cause candidiasis, which can affect the mucous membranes, skin, and bloodstream.
- *Cryptococcus neoformans*: a cause of cryptococcosis, primarily affecting the central nervous system.

2. **Molds:** are multicellular fungi with filamentous structures. They can produce asexual and sexual spores. Some medically important molds include:

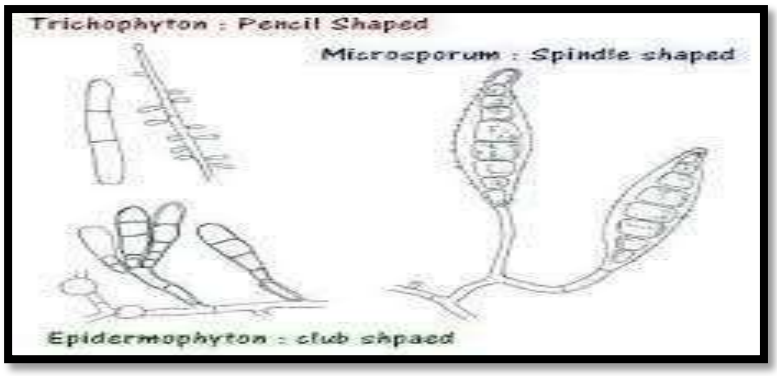
- *Aspergillus* spp.: responsible for diseases such as aspergillosis, which can affect the lungs, sinuses, and other organs.
- *Zygomycetes*: this group includes molds like Rhizopus and Mucor, which can cause invasive fungal infections in immunocompromised individuals.



3. **Dimorphic Fungi:** these fungi can exist as yeasts at body temperature (37°C) and as molds at room temperature. Examples include:
    - *Histoplasma capsulatum*: causes histoplasmosis, often affecting the lungs.
    - *Blastomyces dermatitidis*: responsible for blastomycosis, which can affect the lungs and other tissues.



4. **Dermatophytes:** these fungi specialize in infecting the skin, hair, and nails. Common dermatophytes include Trichophyton, Microsporum, and Epidermophyton species. They cause conditions like ringworm (tinea) and athlete's foot.



5. Opportunistic Fungi: these fungi are generally harmless to healthy individuals but can cause infections in immunocompromised patients. Examples include various Candida species, Aspergillus, and *Pneumocystis jirovecii*.

6. Endemic Fungi: certain fungi are associated with specific geographic regions and can cause endemic mycoses. Examples include *Coccidioides immitis* (causing coccidioidomycosis or Valley fever) and *Paracoccidioides brasiliensis* (causing paracoccidioidomycosis or South American blastomycosis).

الأسبوع الخامس عشر

الهدف التعليمي: التعرف على شكل وتركيب الفطريات الطبية.

مدة المحاضرة: ساعتان.

الأنشطة المستخدمة: أسئلة عصف ذهني.

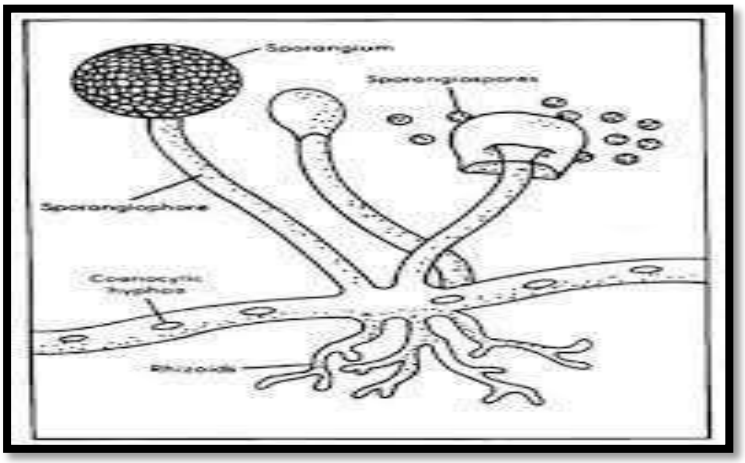
أساليب التقويم: التغذية الراجعة النهائية (التقويم الختامي).

عنوان المحاضرة:

Morphology and structure of fungi, Classes of antifungal agents

Morphology and Structure of Fungi:

Fungi exhibit a diverse range of morphological and structural features, which can vary depending on their life stage and environmental conditions. Here are some key aspects of fungal morphology and structure:



1. **Hyphae:** are thread-like filaments that make up the body of a fungus. They can be either septate (divided by cell walls) or non-septate (coenocytic, lacking cell walls).
2. **Mycelium:** is a mass of intertwined hyphae that forms the vegetative part of the fungus. It serves as the feeding structure and can grow extensively in the substrate.
3. **Spores:** fungi reproduce through the production of spores, which can be sexual or asexual. Spores are typically small, durable, and adapted for dispersal. They can have various shapes and structures, including conidia (asexual spores) and basidiospores (sexual spores).

4. **Fruiting Bodies:** in some fungi, such as mushrooms and bracket fungi, the reproductive structures are highly visible and are called fruiting bodies. These structures produce and release spores.
5. **Cell Wall:** fungal cell walls are primarily composed of chitin, a complex sugar molecule. This distinguishes them from the cell walls of plants (cellulose) and bacteria (peptidoglycan).
6. **Nuclei:** fungal cells contain multiple nuclei, often distributed throughout the hyphal network. This multinucleate condition is called coenocytic or aseptate.
7. **Rhizoids:** are specialized hyphae that anchor the fungus to the substrate and aid in nutrient absorption.
8. **Morphological Variations:** fungi can exhibit a wide range of morphological variations, including yeast forms (single-celled), filamentous molds, and dimorphic fungi (which can exist as both yeasts and molds).

Classes of Antifungal Agents:

Antifungal agents are medications or compounds designed to treat fungal infections (mycoses) by inhibiting fungal growth or killing the fungi. These agents can be classified into several categories based on their mechanisms of action. Here are some of the main classes of antifungal agents:

1. **Polyenes:**
    - Examples: Amphotericin B, Nystatin.
    - Mechanism: bind to ergosterol in fungal cell membranes, leading to membrane disruption and cell death.
    - Use: severe systemic fungal infections.
2. **Azoles:**
    - Examples: Fluconazole, Ketoconazole, Itraconazole, Voriconazole.
    - Mechanism: inhibit ergosterol synthesis, a key component of fungal cell membranes.

- Use: broad-spectrum antifungals used for various fungal infections.

3. **Echinocandins:**
    - Examples: Caspofungin, Micafungin, Anidulafungin.
    - Mechanism: inhibit the synthesis of β-glucan, a component of fungal cell walls.
    - Use: effective against certain Candida and Aspergillus species.
4. **Allylamines:**
    - Examples: Terbinafine, Naftifine.
    - Mechanism: inhibit the enzyme squalene epoxidase, disrupting fungal cell membrane synthesis.
    - Use: used topically for dermatophyte infections, such as athlete's foot and ringworm.
5. **Pyrimidine Analog:**
    - Example: Flucytosine (5-Fluorocytosine).
    - Mechanism: interferes with fungal RNA and DNA synthesis.
    - Use: often used in combination therapy for systemic fungal infections.
6. **Topical Antifungals:**
    - Examples: Clotrimazole, Miconazole, Terbinafine (topical formulation).
    - Mechanism: used for superficial fungal infections, often targeting the skin, nails, and mucous membranes.