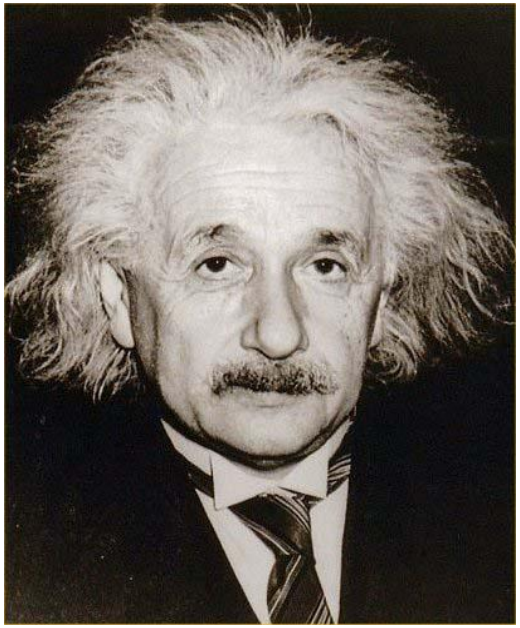
Welcome to Micro-biology

"You do not really understand something unless you can explain it to your grandmother."

--Albert Einstein



Microbes help us by

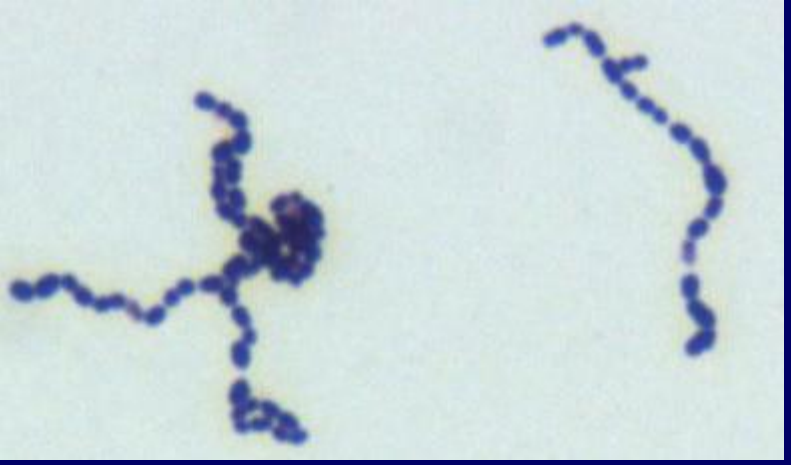
- decomposing organic waste
- performing photosynthesis
- producing ethanol, acetone, vinegar, cheese, bread, . . .
- producing insulin and many other drugs
- . . .

Microbes harm us by

-
-

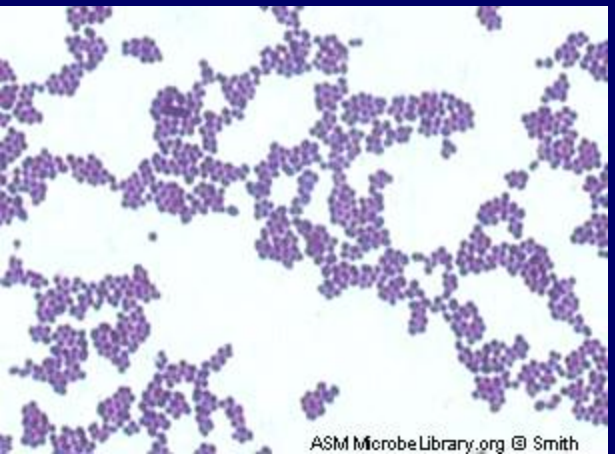
Naming and Classifying Microorganisms

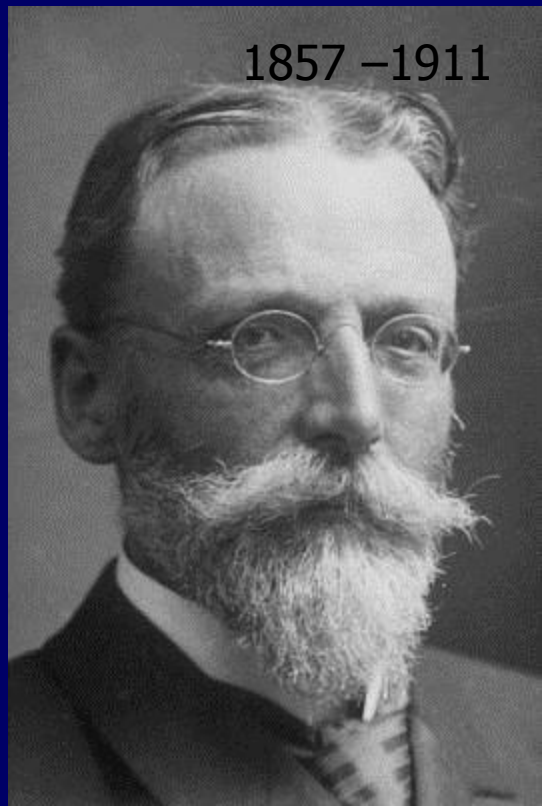
- Carolus Linnaeus established the system of **scientific nomenclature** in 1739.
- Each organism has two names → **Binomial nomenclature**: ***Genus* + *specific epithet*** *(species)*
- *Italicized* (or <u>underlined</u>), genus capitalized, "latinized", used worldwide.
- May be descriptive or honor a scientist.



Examples

- *Staphylococcus aureus (S. aureus)*
- *Escherichia coli (E. coli)*
- *Streptococcus pneumoniae (S. pneumoniae)*



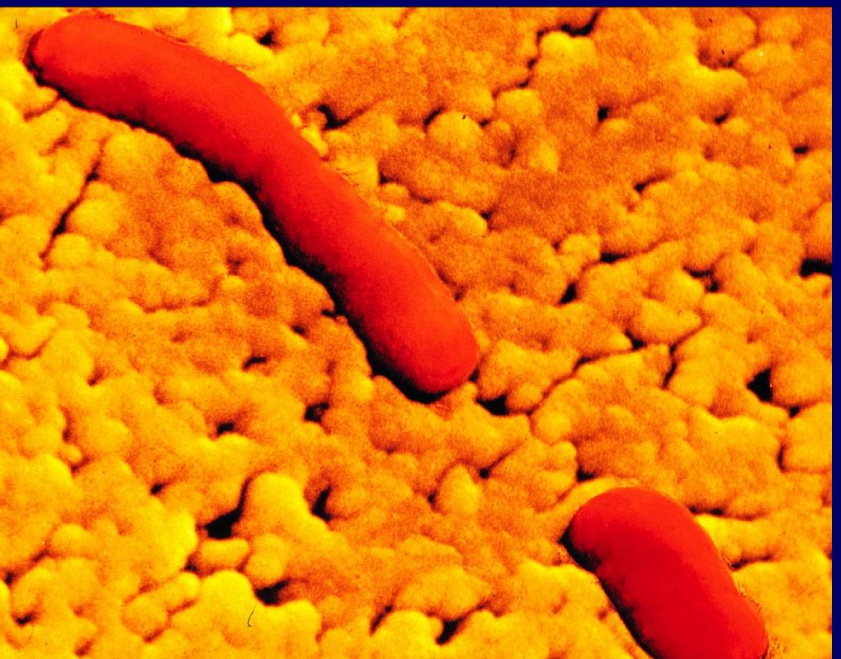


Types of Microorganisms

- Bacteria
- Archaea
- Fungi
- Protozoa
- Algae
- Viruses
- Multicellular animal parasites
- Prions

Bacterium / Bacteria

- Prokaryotic
- Peptidoglycan cell wall
- Reproduction by binary fission



Gain energy from use of

- organic chemicals
- inorganic chemicals or
- photosynthesis

Archaea

- Prokaryotic
- No peptidoglycan
- Live in extreme environments
- Include
  - Methanogens
  - Extreme halophiles
  - Extreme thermophiles

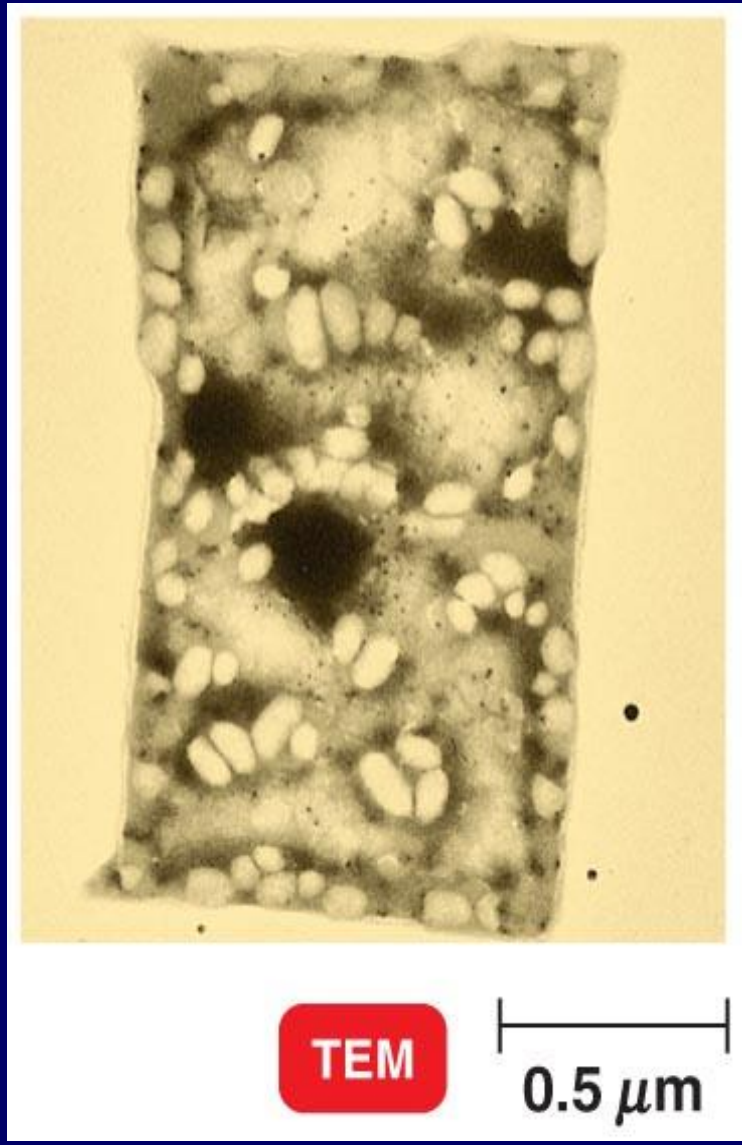
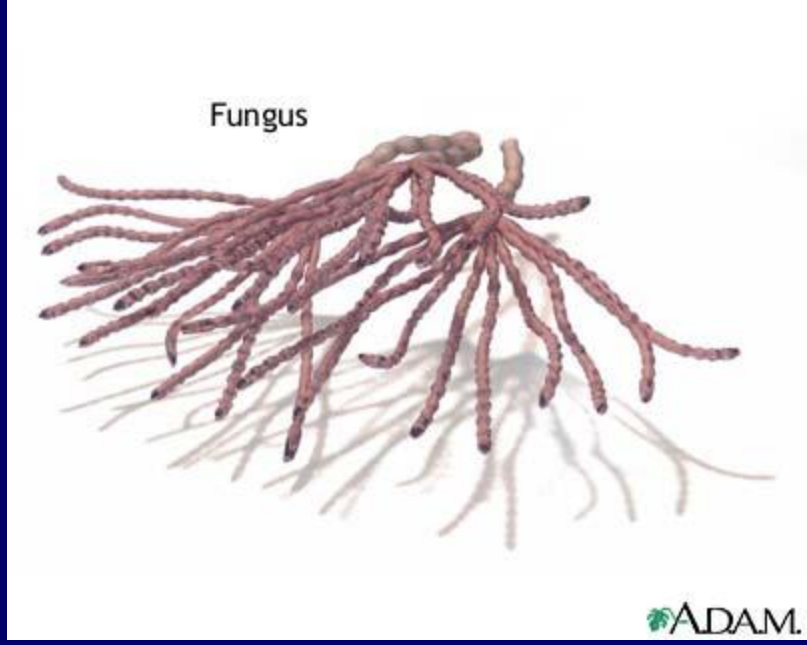


Figure 4.5b

Fungus/Fungi



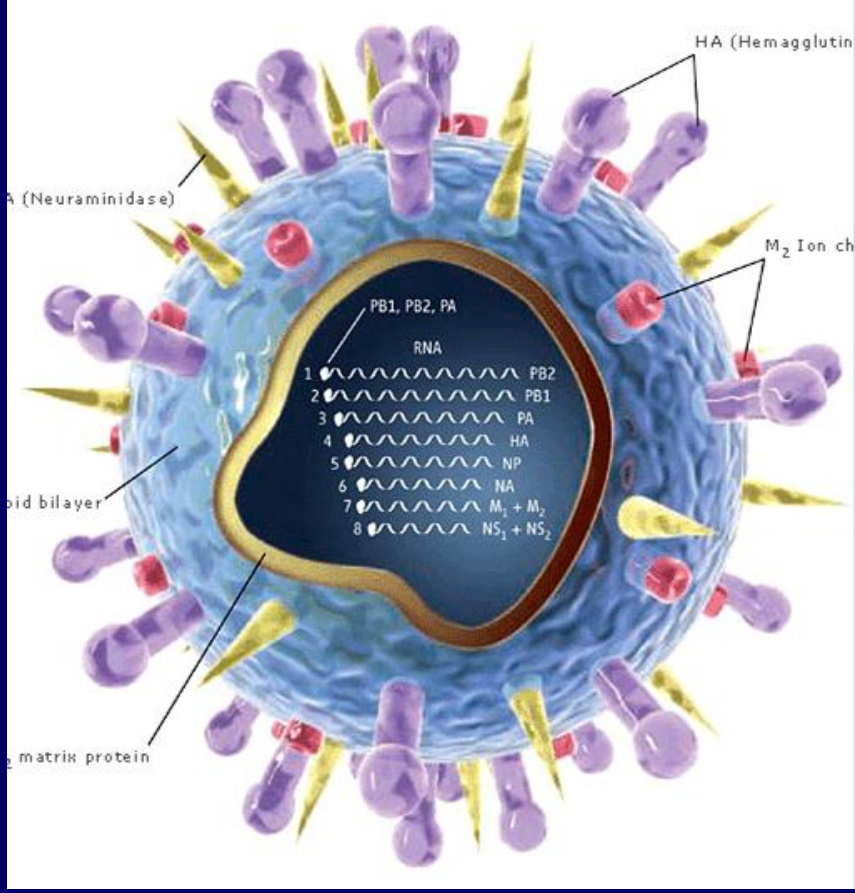
- Eukaryotic
- Chitin cell walls
- Use organic chemicals for energy.
- Molds and mushrooms are multicellular consisting of masses of mycelia, which are composed of filaments called hyphae.
- Yeasts are unicellular.

Protozoan / Protozoa

- Eukaryotes
- Absorb or ingest organic chemicals
- May be motile via pseudopods, cilia, or flagella

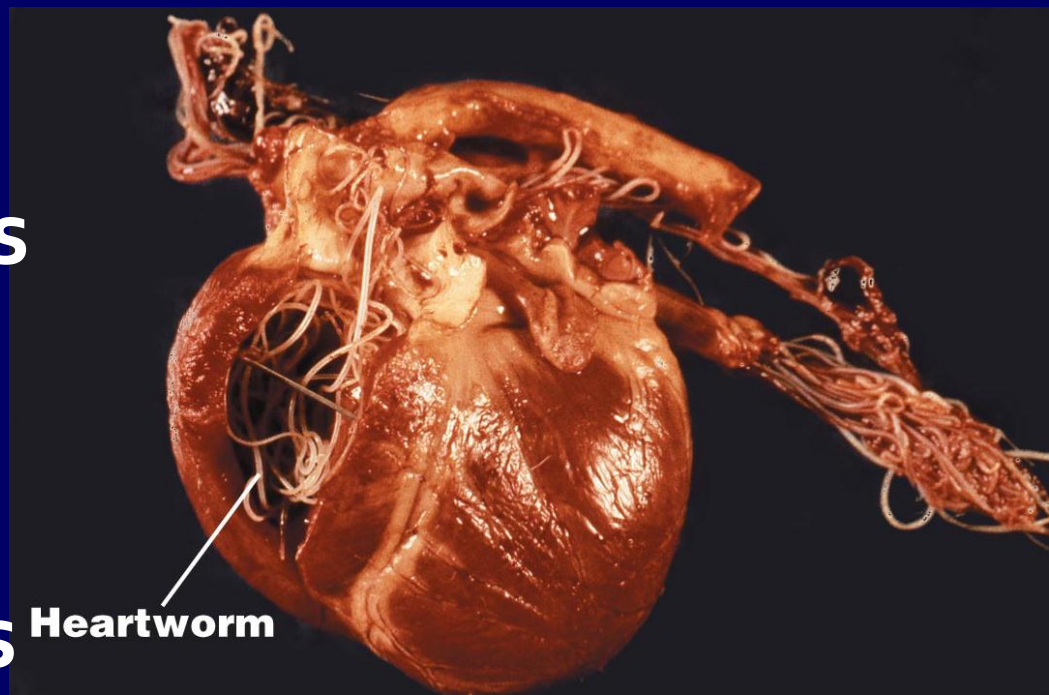
Viruses

- Are acellular
- Have either DNA *or* RNA in core
- Core is surrounded by a protein coat.
- Coat may be enclosed in a lipid envelope.
- Viruses only replicate within a living host cell.



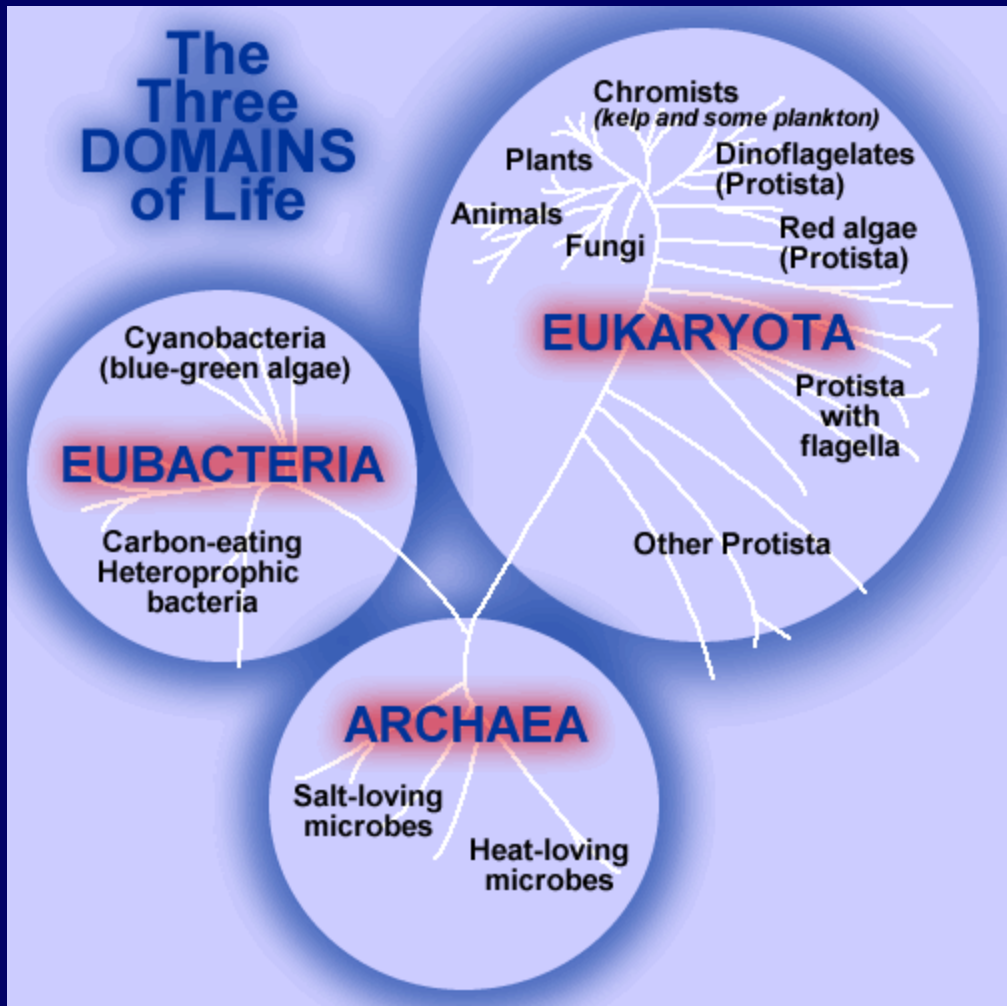
Multicellular Animal Parasites

- Eukaryotes
- Multicellular animals
- Helminths are parasitic flatworms and round worms
- Microscopic stages in life cycles



Three Domain Classification

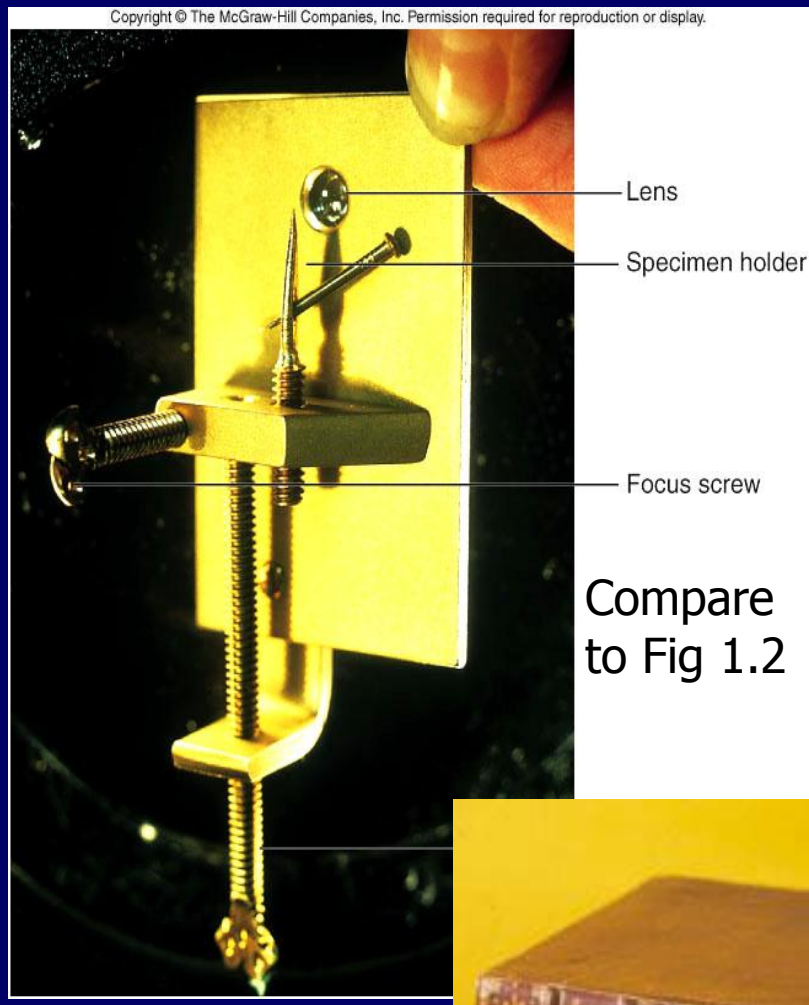
- **Bacteria**
- **Archaea**
- **Eukarya**
  - Protista
  - Fungi
  - Plants
  - Animals



Microbiology History

The Beginnings

- Ancestors of bacteria were the first life on Earth
- 1665: Cell theory – Robert Hooke



Compare to Fig 1.2

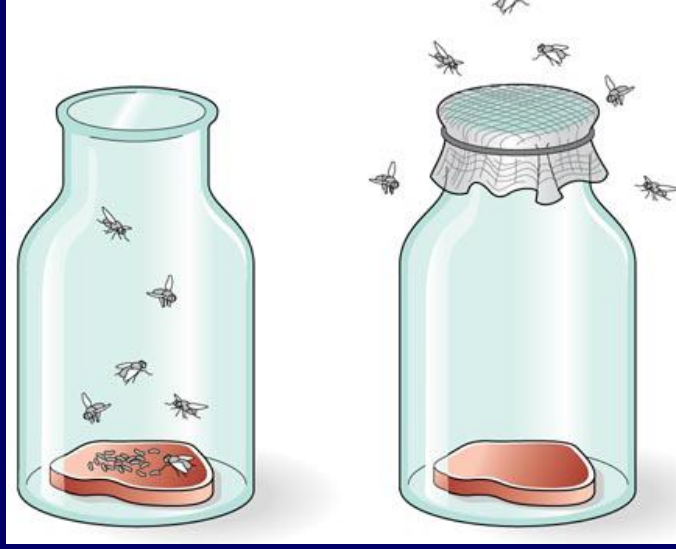
- 1673: First microbes observed – Anton van Leeuwenhoek

The Transition Period: Debate over Spontaneous Generation

- **Aristotles's doctrine of spontaneous generation.** Hypothesis that living organisms arise from nonliving matter; a "vital force" forms life
- **Biogenesis**: Hypothesis that the living organisms arise from preexisting life

1668:Francesco Redi

- the beginnings of experimental science
- filled 6 jars with decaying meat



Conditions	**Results**
Three jars covered with fine net	No maggots
Three open jars	Maggots appeared
From where did the maggots come? What was the purpose of the sealed jars? S*pontaneous generation or biogenesis?*	

1745: John Needham

- Objections
- Put boiled nutrient broth into covered flasks

Conditions	**Results**
Nutrient broth heated, then placed in sealed flask	Microbial growth
From where did the microbes come? S*pontaneous generation or biogenesis?*	

1765: Lazzaro Spallanzani

- boiled nutrient solutions in flasks

Conditions	**Results**
Nutrient broth placed in flask, heated, then sealed	No microbial growth
S*pontaneous generation or biogenesis?*	

1861: Louis Pasteur

- demonstrated that microorganisms are present in the air

Conditions	**Results**
Nutrient broth placed in flask, heated, not sealed	Microbial growth
Nutrient broth placed in flask, heated, then sealed	No microbial growth
Spontaneous generation or biogenesis?	

Confirmation of Biogenesis

Pasteur's **S-shaped (swan-neck) flask** kept microbes out but let air in

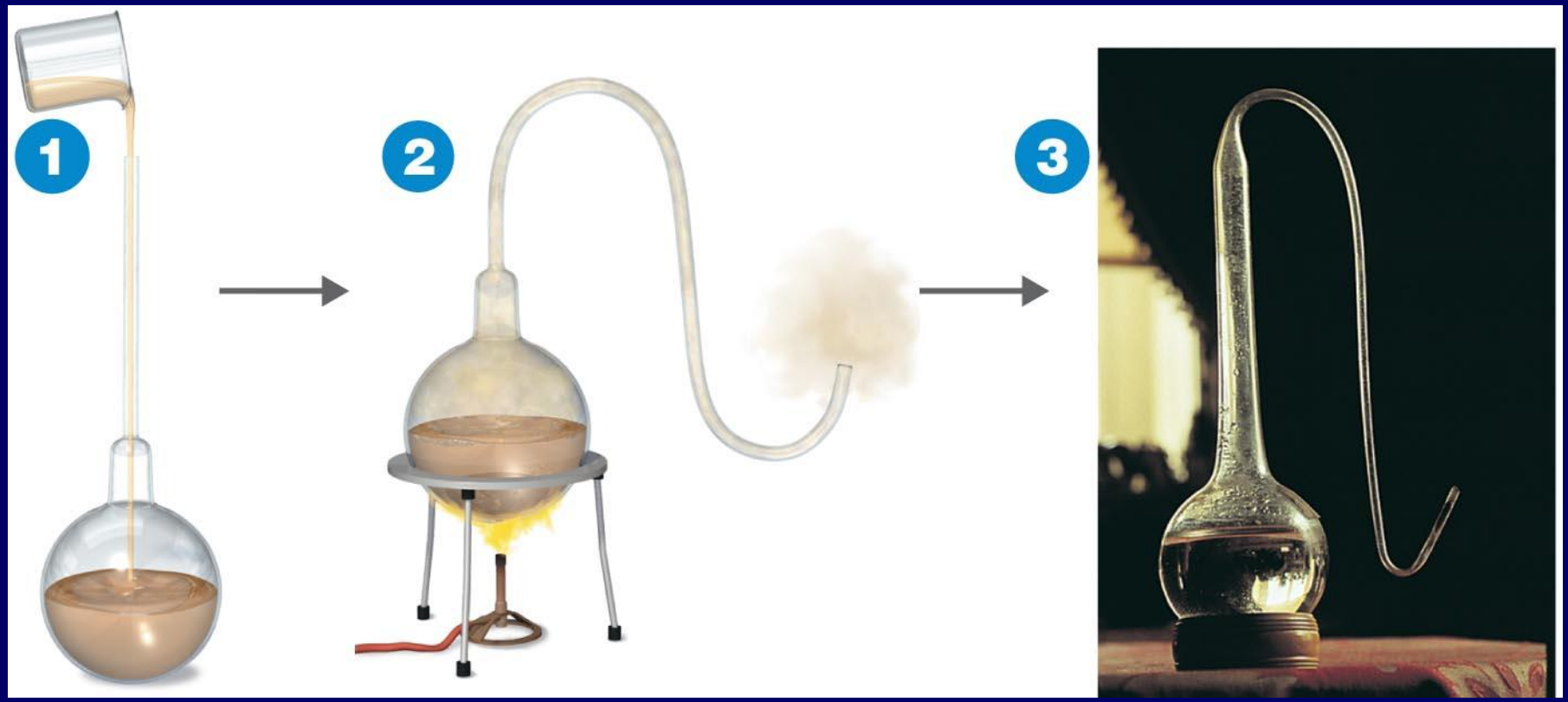


Figure 1.3

The Golden Age of Microbiology(1857-1914)

Microbiology established as a science

Louis Pasteur

- Spontaneous generation disproved
- Wine fermentation (yeasts and bacteria)
- Pasteurization

Pre-Pasteur:

- Ignaz Semmelweis (1840s) – hand disinfection and puerperal fever

Based on Pateur's and Semmelweis' findings: Joseph Lister (1860s) – antiseptic surgery (phenol)

Robert Koch

- Work on anthrax proves the **germ theory of disease**
- Procedures become Koch's postulates (see Ch 14)
- Development of pure culture technique

Nobel Prize in 1905

Nobelprize.org

Before the Golden Age Period: The Birth of Vaccination

- Jenner and smallpox vaccination (1796)

- ~ 100 years later: Pasteur shows how vaccinations work. (Creation of avirulent strains of bacteria during extended laboratory cultivation)

The Birth of Modern Chemotherapy

- 1910: Paul Ehrlich developed a synthetic arsenic drug, salvarsan, to treat syphilis
- 1930s: Synthesis of sulfonamides
- 1928: Alexander Fleming and the discovery of the **first antibiotic**

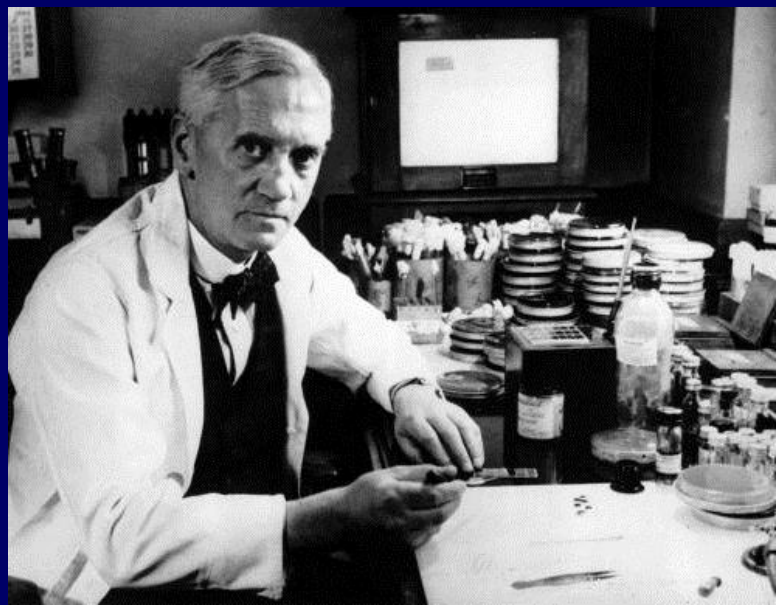


Fig 1.5

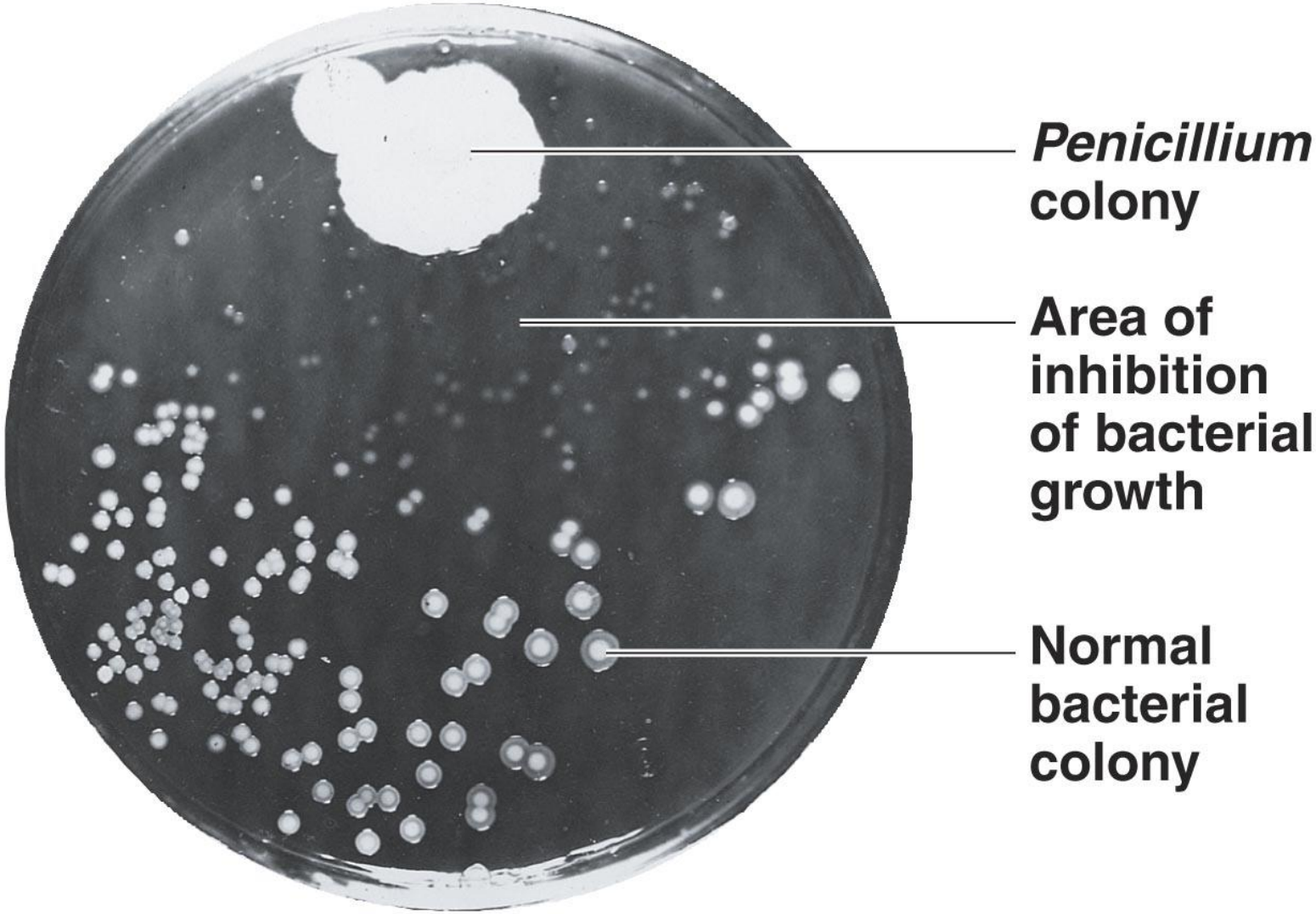


Fig 1.5

enicillin purification and clinical trials not until 1940s

Modern Developments in Microbiology

- Bacteriology – Mycology – Parasitology – Virology – Immunology

- Microbial genetics and molecular biology lead to **Recombinant DNA Technology** (genetic engineering). Prokaryotic model system: *E. coli*

Selected Nobel Prizes for Microbiology Research

1901	von Behring	Diphtheria antitoxin
1902	Ross	Malaria transmission
1905	Koch	TB bacterium
1908	Metchnikoff	Phagocytes
1945	Fleming, Chain, Florey	Penicillin
1952	Waksman	Streptomycin
1969	Delbrück, Hershey, Luria	Viral replication
1987	Tonegawa	Antibody genetics
1997	Prusiner	Prions
2005	Marshall & Warren	*H. pylori* & ulcers

Microbes and Human Disease – Again many Challenges –

- Normal microbiota *(flora)* in and on the human body
- Pathogens overcome the host's resistance → infectious disease
- Antimicrobial resistance
- Bioterrorism
- (Re-)emerging infectious diseases (EID): WNE, avian influenza, SARS, BSE, HIV/AIDS . . .

West Nile Encephalitis

- Caused by West Nile virus
- First diagnosed in the West Nile region of Uganda in 1937
- Appeared in New York City in 1999

Avian influenza A

- Influenza A virus (H5N1)
- Primarily in waterfowl and poultry
- Sustained human-to-human transmission has not occurred yet

MRSA

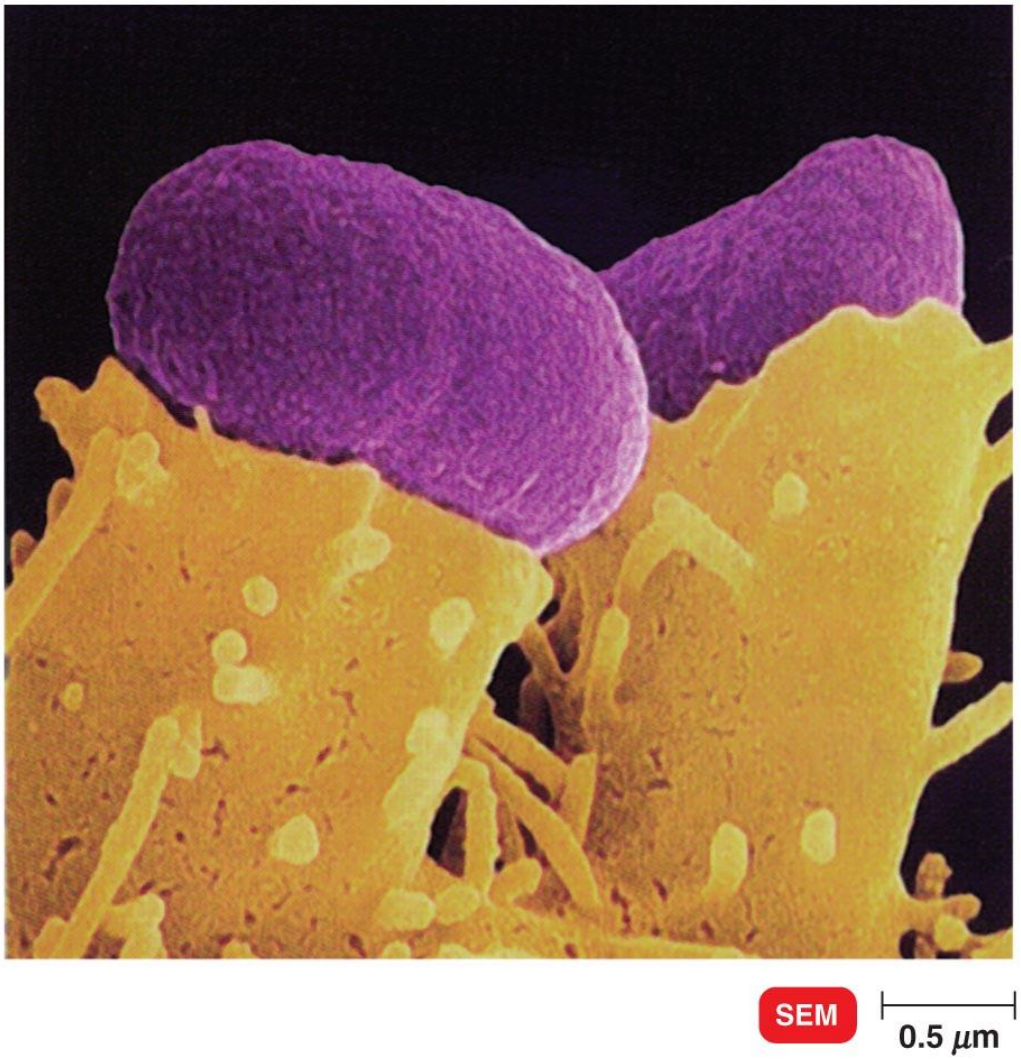
- Methicillin-resistant *Staphylococcus aureus*
- 1950s: Penicillin resistance developed
- 1980s: Methicillin resistance
- 1990s: MRSA resistance to vancomycin reported
  - VISA: Vancomycin-intermediate-resistant *S. aureus*
  - VRSA: Vancomycin-resistant *S. aureus*

Bovine Spongiform Encephalopathy

- Caused by a prion
- Also causes Creutzfeldt-Jakob disease (CJD). New variant CJD in humans is related to beef consumption

Escherichia coli O157:H7

- Toxin-producing strain of *E. coli*
- First seen in 1982
- Leading cause of diarrhea worldwide



Acquired immunodeficiency syndrome (AIDS)

- Caused by human immunodeficiency virus (HIV)
- First identified in 1981
- Worldwide epidemic infecting 30 million people; 14,000 new infections every day
- Sexually transmitted infection affecting males and females
- HIV/AIDS in the U.S.: 30% are female, and 75% are African American

The End

Lecture Two; Bacterial Morphology, Bacterial structure

Bacterial morphology

What bacteria look like?

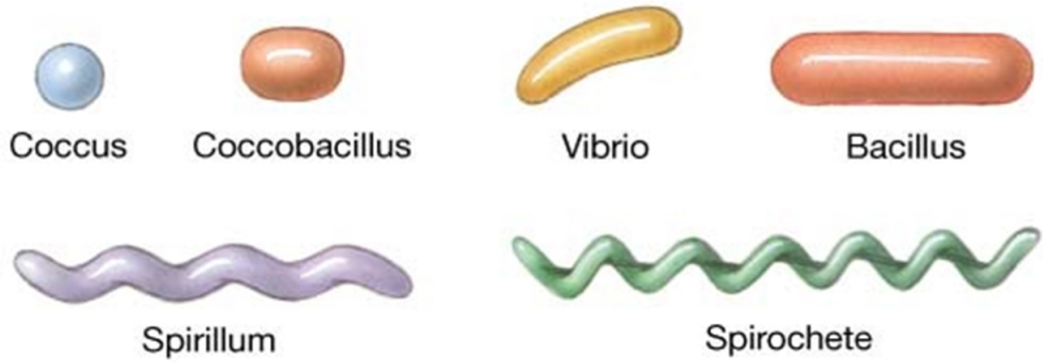
Bacterial exhibit several distinct shape, or morphologies. The most common shapes, and the terms are given by microbiologist are

Spherical = coccus (plural: cocci)

Rod = bacillus (plural: bacili)

Curved rod = vibrio (plural: vibrios)

Spiral = spirillum (plural: spirilla)



The shape of bacterial cells is determined by the organization of the cell wall, the semi-rigid structure surrounding the cell. Morphology is a fairly reliable features of most bacterial a species. For instance, *Escherichia coli* cells generally are straight rods, *Vibrio cholerae* cells are curved, *staphylococcus aureus* cells are spherical, and *Bacillus subtilus* cells are long *Treponema pallidum* cells are (spirochete) long thin spirals. However, because many bacterial species have similar morphologies and because environmental conditions and stress can sometimes cause changes in bacterial morphology, physical appearance is seldom conclusive for identifying bacterial species.

For many bacterial species, like *E. coli*, individual cells typically remain separate from each other. The cells of other bacteria stay physically connected after they divided. For example, the rod-shape cells of *Bacillus anthracis*, the cause of anthrax, and the spherical cells of *Streptococcus pyogens*, the cause of strep throat, often are seen in long chains. In contrast, Staphylococcus cells tend to form irregular clusters rather than chains.

Some bacteria do not exhibit regular shapes, but may exhibit highly variable shapes. These bacteria are preferred to as pleiomorphic. Examples of these pleiomorphic bacteria include member of the genus Mycobacterium, which do not make a cell wall, as a result, do not have a regular shape. Some bacteria grow in most complex multicellular arrangement. Soil bacteria for the actinomycete group grow as irregularly branching filamentous called hyphae that are composite of chains of cells. Hyphae can form three dimensional network called mycelia that can rise above the substrate, penetrate down to the soil, or both. Many fungi eukaryotical organisms, form hyphae and mycelia superficially similar to the hyphae and mycelia formed by the bacterial species.

Just as bacteria come with range of shapes, bacteria also come in range of sizes, with cells of most bacterial species being somewhere between 0.5 μm and 5μm in length. Bacteria are usually smaller than eukaryal cells; even small eukaryal microbes such as yeast are typically at least 5μm in diameter.

Most bacteria cannot be seen by the unaided human eye. Microscopy, therefore, is an integral tool of microbiologist. Different types of microscopes, like electron microscopes and light microscop.es, aloe as to see objects of different sizes.

Bacterial cell structure

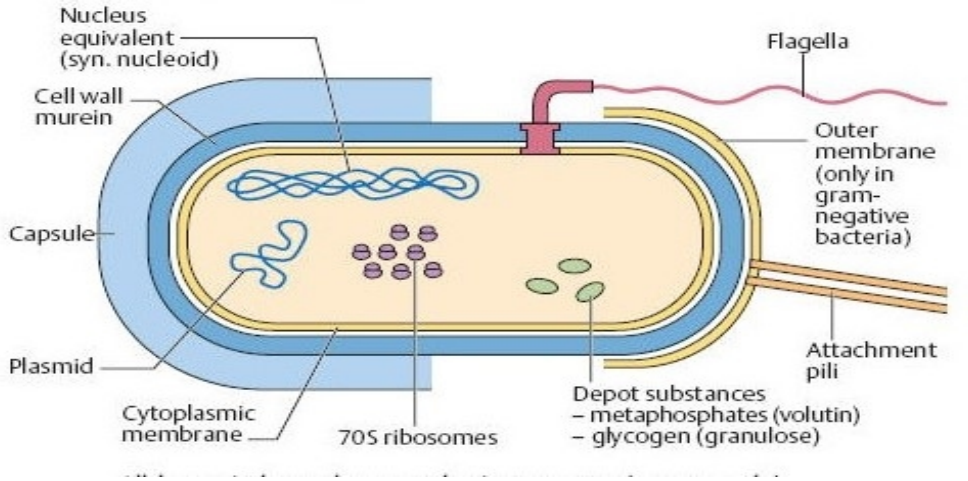
Capsule - Some species of bacteria have a third protective covering, a capsule made up of polysaccharides (complex carbohydrates). Capsules play a number of roles, but the most important are to keep the bacterium from drying out and to protect it from phagocytosis (engulfing) by larger microorganisms. The capsule is a major virulence factor in the major disease-causing bacteria, such as *Streptococcus pneumonia*

Cell wall: Each bacterium is enclosed by a semi-rigid cell wall. The bacterial cell wall consist of a highly crosslinked polysaccharide-peptide (protein-sugar) matrix called peptedoclycan. The cell wall necessary for bacterial shape and protection. The wall gives the cell its shape and surrounds the cytoplasmic membrane, protecting it from the environment, resist damage from osmotic pressure, mechanical force and shearing. The organization of peptedoglycan also give the bacterial cells their characteristic shapes.

The cell envelope: All cells are spatially defined at least one membrane, the plasma membrane. Most bacterial cells also contain the cell wall, and some bacterial cell contains a second membrane, the outer membrane. These layers in total are referred tp as the cell envelope. **Plasma membrane:** Also refer to as cytoplasm Membrane: A layer of phospholipids and proteins, the structure of these phospholipids is amphipathic, meaning have a polar portion and a nonpolar potion. Encloses the interior of the bacterium, regulating the flow of materials in and out of the cell. This is a structural characteristic bacteria share with all other living cells; a barrier that allows them to selectively interact with their environment. Membranes are highly organized and asymmetric having two sides, each side with a different surface and different functions. Membranes are also dynamic, constantly adapting to different

conditions.

Cytoplasm: The cytoplasm or protoplasm; is the aqueous environment within the plasma membrane. Contain a diverse array of component.The cytoplasm of bacterial cells is where the functions for cell growth, metabolism, and replication are carried out. It is a gel-like matrix composed of water, enzymes, nutrients, wastes, and gases and contains cell structures such as ribosomes, a chromosome, and plasmids. Unlike the eukaryotic (true) cells, bacteria do not have a membrane enclosed nucleus. The chromosome, a single, continuous strand of DNA, is localized, but not contained, in a region of the cell called the nucleoid. All the other cellular components are scattered throughout the cytoplasm.



Nucleoid: The nucleoid is a region of cytoplasm where the chromosomal DNA is located. It is not a membrane bound nucleus, but simply an area of the cytoplasm where the strands of DNA are found. Most bacteria have a single, circular chromosome that is responsible for replication, although a few species do have two or more. Smaller circular auxiliary DNA strands, called plasmids, are also found in the cytoplasm.

Ribosomes: Ribosomes are microscopic "factories" found in all cells, including bacteria. They translate the genetic code from the molecular language of nucleic acid to that of amino acids—the building blocks of

proteins. Proteins are the molecules that perform all the functions of cells and living organisms. Bacterial ribosomes are similar to those of eukaryotes, but are smaller and have a slightly different composition and molecular structure. Bacterial ribosomes are never bound to other organelles as they sometimes are (bound to the endoplasmic reticulum) in eukaryotes, but are free-standing structures distributed throughout the cytoplasm. There are sufficient differences between bacterial ribosomes and eukaryotic ribosomes that some antibiotics will inhibit the functioning of bacterial ribosomes, but not a eukaryote's, thus killing bacteria but not the eukaryotic organisms they are infecting

Flagella: Flagella (singular, flagellum) are hairlike structures that provide a means of locomotion for those bacteria that have them. They can be found at either or both ends of a bacterium or all over its surface. The flagella beat in a propeller-like motion to help the bacterium move toward nutrients; away from toxic chemicals; or, in the case of the photosynthetic cyanobacteria; toward the light.

Pili: Many species of bacteria have pili (singular, pilus), small hairlike projections emerging from the outside cell surface. These outgrowths assist the bacteria in attaching to other cells and surfaces, such as teeth, intestines, and rocks. Without pili, many disease-causing bacteria lose their ability to infect because they're unable to attach to host tissue. Specialized pili are used for conjugation, during which two bacteria exchange fragments of plasmid DNA.

Growth curve

Counting of bacteria at different period after inoculation and then event of sequences are represented on a graph which is Called growth curve.

The growth curve consists of several phases: -

1-Lag phase : the number of cells remain constant.

2-Acceleration phase : the cell division start and the number of bacteria cells increased.

3-Log phase: the population is double in a definite and constant time.

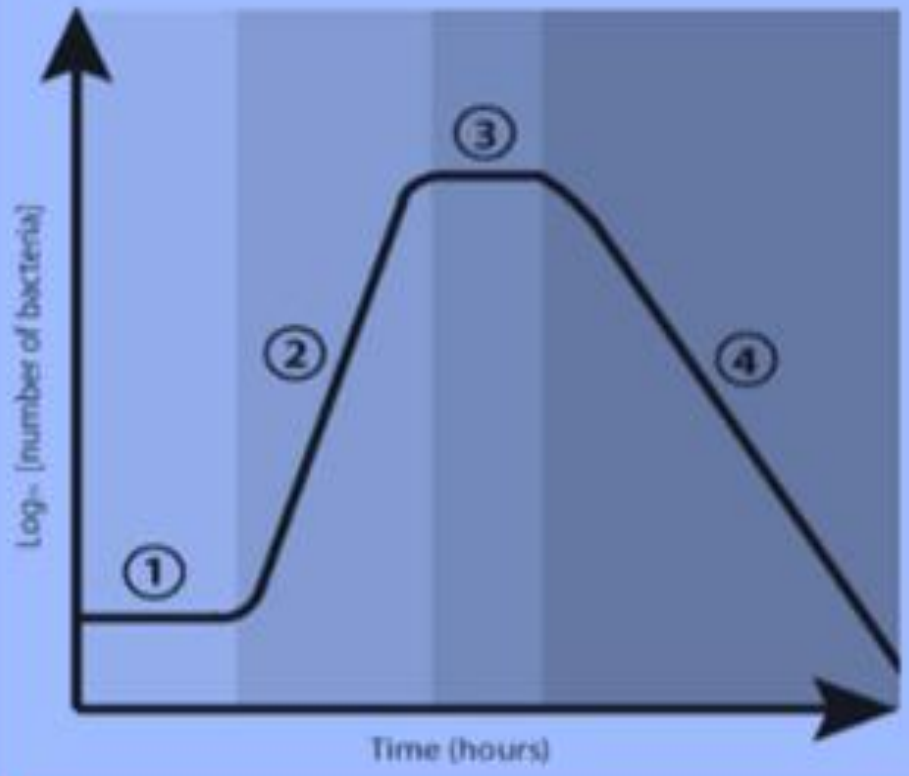
4- Retardation phase : some cell start to die with the reduction of cell division because of the nutrition deficiency.

5-Stationary phase : the rate of cell division and cell death are equal , due to:

a- Decrease of nutrition.
b- Accumulation of toxic products.

6- Death phase – the population decrease due to death of cells.

The Bacteria Growth Curve



1. Lag phase
2. Log, or exponential growth, phase
3. Stationary phase
4. Death, or logarithmic decline, phase

Factors responsible for this phase are:

1- Nutritional exhaustion.

2- Toxic accumulation.

3- Auto lytic enzymes.

Factors influencing growth

1- Temperature :

The temp. range at which an organisms growth best is called (optimum temp.) in human parasitic organisms(opt. temp.) range between (30-37 c) .

There are three group of bacteria as regards the temp. of growth :

a- Psychrophilic – organisms growing (0-25 c): they are mostly soil and water bacteria.
b- Thermophilic – they grow (50 – 60 c) ex. *Bacillus* and algae .
c- Mesophilic – they grow (20 – 45 c) : this group includes pathogenic bacteria .

2- Hydrogen ion concentration (pH) :

Most pathogenic bacteria grow at ph (6-8) and the opt. ph (7.2 – 7.6).

3- Moisture :

3- Moisture :

Water in quite essential for the growth of bacteria ex. *N. gonorrhea* dies on drying

4- Osmotic pressure :

osmophilic bacteria need high osmotic pressure .

5- Light :

Organisms are sensitive to ultraviolet and other radiation.


I'M HERE FOR YOU

Sterilization and disinfection

Sterilization

It is process by which articles are freed of all micro-organisms either in vegetative or spore state.

Disinfection

It is a process of destruction of pathogenic organism capable of giving rise to infection.

Antiseptic

It means prevention of infection by inhibiting growth of bacteria .

Bactericidal

They are those which are able to kill bacteria

Bacterost

Only prevent multiplication of bacteria and they may remain alive .

Various agents used in sterilization are:

a- Physical :-

1- Sun light:it Bactericidal activity. The action is due to ultraviolet ray

2- Drying: drying in air has effect on many bacteria.

3- Heat: the factors influencing sterilization By heat are :-

a- Nature of heat

b- Temperature and time

c- Number of organisms present

d- Whether organism has spore capacity.

A-Dry heat :

B-Red heat: - it is used to sterilize metallic objects by holding them in a flam till they are red hot ex. Wire loop , needles , scalpels , forceps, etc. …..

C-Flaming: the article is passed over flam without allowing it to become red hot ex. culture tubes, glass, slides ….

D- **Hot air oven**: requires temp. of 160 ºCfor one hour . we can sterilize all glass , syringes , petri-dishes , test tubes , flask , scissors etc…..

1- Moist heat: the lethal effect is by denaturation and coagulation of protein .

a- Temp. below 100ºC

Pasteurization of milk :temp. employed is either :-

63Cº for 30 mints – holder method or:

72Cº for 15-20 second – flash method

Mycobacterium , *Salmonella* , *Brucella* , are killed .

b- Temp. at 100C° .

1- Tantalization : this is process by which medium is placed at 100c inflowing steam for 30 min. each on 3 successive days .

2- Boiling : most of vegetation from of bacteria , fungi and viruses are killed 50-70 C° in short time for needles and instruments boiling in water for 10 -30 min , is sufficient to ste. them .

3- Steam under pressure : autoclave is used for bacteriological and surgical work , because of spores kills all microorganisms including (HIV & hepatitis virus) .

Filtration:

Is the method of ster. Used filter paper useful for antibiotic solutions, sera, etc.

- Used to produse particles and pyrogen –free fluid.
- Composed of nitrocellulose
- Work by electrostatic attraction and physical pore size
- Purify drinking water

- To recover very small number of organism from large volumes .
- Can be used for quantitating bacteria in fluid .

Ex. Asbestos disc filter , membranous filter

.

Radiation:

Ultraviolet radiations it is chief Bactericidal factor present in sun light. It cause following changes in cell:

1- Denaturation of protein.
2- Damage to DNA.
3- Inhibition of DNA replication.
4- Formation of H_2O_2 and organic peroxide in medium.

X-rays and other ionizing radiations:

Ion. rad . Have greater capacity to induce lethal changes in DNA of cell. Useful for ster. of disposable materials.

B-Chemical methods:

1- Acid and alkaline: growth bacteria inhibition. *Mycobacterium* is more resistant to acid than alkaline.
2- Halogens: iodine is used chiefly for skin. Chlorine combines with water to form hypochloric acid which is Bactericidal.
3- Formaldehyde: useful in ster. Bacterial vaccine and in inactivating bacterial toxin without affecting their antigenicity. (5-10%) solution in water kills many bacteria. it is Bactericidal, sporicidal and lethal to viruses also.
4- Dry:gentian violates and malachite green etc. are active against gram positive bacteria.
5- Soap and detergents: they are Bactericidal and bacteriostatic for gram positive bacteria and some acid fast organisms.
6- Aerosol and gaseous disinfectants SO2 : chlorine and formalin vapor have been used as gaseous disinfectant . Propylene, glycol is powerful disinfectant.


thinking of you

Diphtheroids

Organism which are not distinguished morphologically from

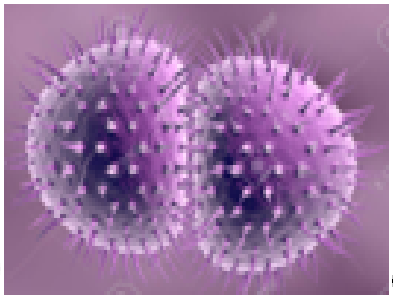
Cory. Diphtheria and are non pathogenic. They are found on:

Conjunctiva, mucosa membrane of nasopharynx, oral cavity & genitalia

Difference between diphtheria & diphtheroids

Diphtheria	Diphtheroids
A-Morphology: 1- G p & thin 2-Meta chromatic granules are more. 3-Pleomorphism present. 4- Chines letter arrangement.	**A-Morphology:** 1-G p ,short & thick 2-They are less or absent 3-Very little pleomorphism 4- No arrangement is seen
B-Culture: Grow on enriched media.	**B-Culture:** Many grow on ordinary media,
C-Biochemical reaction : Ferment glucose only.	**C-Biochemical reaction** Many ferment glucose & sucrose.
D-They are toxic	**Non toxic**

Neisseria



General character:-They are Gram negative, aerobic, none sporulating, non motile, oxidase positive cocci arranged in pairs. The genus contains about30 species. Two important pathogens are:

1-***Neisseria meningitidis.***

2-Neisseria gonorrhea.

Neisseria meningitides:

Morphology:

They are Gram negative, oval or spherical, arranged in pair with adjacent sides flattened.

Classification:

They are divided into 4 groups A, B, C, D. Three new groups have also recognized E,F and G.

Resistance:

They are highly susceptible to heat, desiccation, alteration in pH and disinfectants. They may acquire resistance to streptomycin readily.

Pathogenecity:

Meningococci are strict human parasites. The route of infection is usually nasopharynx. They produce cerebrospinal meningitis and meningococcal septicemia.

Meningococcaemia: Presents as acute fever with chills and malaise. Haemorrhagic manifestation is characteristic. In early disease petechial rash may occur. Meningococci may be isolated from petechial rash lesion. There may be metastatic involvement of joint, ear, lungs, and adrenals.

Toxin: Endotoxin is released by the autolysis of organism. There are heamorrhagic manifestations.

Neisseria gonorrhoeae:

Morphology: it is strictly a parasite of man. The coccus is Gram negative, oval or spherical with adjacent side concave(bean shaped) arranged in pair. It is found predominantly within the polymorphs.

Classification:

On the basis of colony morphology, autoagglutinability and virulence there are four biotypes (T1, T2, T3, T4). T1&T2 are small, brown, autoagglutinable and virulent. T3&T4 produce large non pigmented colonies which are avirulent.

Resistence: They are killed by heat, drying and antiseptics. It is susceptible to sulfonamides, pencillin and other antibiotics.

Pathogenecity: The gonococcus is a specific human parasite causing a venereal disease called gonorrhea. It produces lesion as follows:

Incubation period is 2-8 days. In male it starts as acute urethritis with mucopurulent discharge containing gonococci. Infection may exted along urethra to prostate, seminal vesicle and epididymis.

In females infection involves urethra and cervix uteri. Vagina is spared because of acidic pH. The infection may spread to Bartholin glands, endometrium and fallopian tubes.

Pharyngitis and conjunctivitis may occur. Opthalmia neonatorum occurs in new borne as a result of infection from genital tract of mother.


thank you

Outcome of lecture

The purpose of this lecture is to introduce you to terminology used in microbiology. The lecture will:

1. Cover different classification schemes for grouping bacteria, especially the use of the Gram stain
2. Describe the different types of bacteria
3. Discuss bacterial structure and the function of the different bacterial components
4. Discuss the distinguishing characteristics of Gram positive and Gram negative bacteria.

Classification Systems

The classification of bacteria serves a variety of different functions. Because of this variety, bacteria may be grouped using many different typing schemes.

These schemes utilize the bacterial **morphology** and **staining properties** of the

organism, as well as **O2 growth requirements** of the species combined with a variety of biochemical tests.

Gram stain and bacterial morphology

Gram stain has resist the test of time Discovered by H.C. Gram in 1884 it remains

an important and useful technique to this day. It allows a large proportion of clinically important bacteria to be classified as either Gram positive or negative based on their morphology and differential staining properties.

Slides are sequentially stained with

1) **crystal violet**
2) **iodine**
3) then destained with **alcohol**
4) counter-stained with **safranin**.

Gram positive bacteria stain blue-purple and Gram negative bacteria stain red. The

difference between the two groups is believed to be due to a much larger peptidoglycan (cell wall) in Gram positives. As a result the iodine and crystal violet precipitate in the thickened cell wall and are not eluted by alcohol in contrast with the Gram negatives

where the crystal violet is readily eluted from the bacteria. As a result bacteria can be distinguished based on their morphology and staining properties.

Some bacteria such as **mycobacteria** (the cause of tuberculosis) are not reliably stained due to the **large lipid content of the peptidoglycan**. Alternative staining techniques (**acid-fast stain**) are therefore used that take advantage of the resistance to destaining after lengthier initial staining.

Growth Requirements: Microorganisms can be grouped on the basis of their need for oxygen to grow.

a. Facultatively anaerobic bacteria can grow in high oxygen or low oxygen

b. strictly anaerobic bacteria grow only in conditions where there is minimal or no oxygen present in the environment such as ***Bacteroides spp*** found in the large bowel are examples of anaerobes.

C. Strict aerobes only grow in the presence of significant quantities of oxygen. *Pseudomonas aeruginosa*, an opportunistic pathogen, is an example of a strict aerobe.

d. Microaerophilic bacteria grow under conditions of reduced oxygen and sometimes also require increased levels of carbon dioxide. *Neisseria species* (*e.g.,* the cause of gonorrhea) are examples of micraerophilic bacteria.

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Bacteria have common structures that are described below.

1) **Slime** (extracellular polysaccharide): This is extracellular material, loosely associated with the bacteria, that is elaborated by some bacterial species that facilitates colonization of smooth, prosthetic surfaces such as intravascular catheters.

2) **Capsule:** This polysaccharide outer coating of the bacterial surface often plays a role in preventing phagocytosis of bacteria.

3) **Peptidoglycan (cell wall)** Provides bacterial shape and rigidity. The cell wall consists of alternating units of N-acetylglucosamine and N-acetylmuramic acid. The polysaccharide chains are cross-linked by a peptide bridge. It is a primary target of antimicrobial therapy – because it is specific to prokaryotes.

4) **Cytoplasmic membrane:** This is a phospholipid bilayer that assumes many of the functions of eukaryotic organelles such as the biosynthetic processes.
5) **Flagella:** These provide bacteria with the capacity for locomotion. They vary in number and location.
6) **Pili:** These structures project from the cell surface enabling bacteria to adhere to host tissue surfaces. Based on their amino acid structure their affinity for particular host tissue surfaces can be remarkably specific.
6) **Secreted products:** There are a variety of these products including exotoxins that are proteins grouped into A-B toxins (such as those elaborated by vibrio, the cause of cholera), membrane damaging toxins (*e.g*., hemolysins) and hydrolytic enzymes capable of destroying host tissues and extracellular matrices.

Distinguishing Features between Gram Positive and Negative Bacteria

Gram positive bacteria have a large peptidoglycan structure. this accounts for the differential staining with Gram stain. Some Gram positive bacteria are also capable of forming **spores** under stressful environmental conditions such as when there is limited availability of carbon and nitrogen. Spores therefore allow bacteria to survive exposure to extreme conditions and can lead to re-infection (*e.g.,* pseudomembranous colitis from *Clostridium difficle*)
Gram negative bacteria have a small peptidoglycan layer but have an additional membrane, the outer cytoplasmic membrane. This creates an additional permeability barrier and results in the need for transport mechanisms across this membrane.
A major component of the cytoplasmic membrane that is unique to Gram negatives is **endotoxin**. This component is essential for bacterial survival. Endotoxin has three components:

1- the **lipid A moiety**
2- the highly conserved **core polysaccharide**
3- the species **specific O antigen** (also polysaccharide).

In contrast with the **secreted exotoxins**, **endotoxin** is cell-associated but can be released during cell division or cell death. The Lipid A moiety of endotoxin is responsible for sepsis which may be fatal. ***Sepsis** is characterized clinically by confusion, fever, drop in blood pressure and ultimately multi-organ failure.
*Endotoxin (also known as lipopolysaccharide-LPS):

Gram Positive Bacteria					
Name	**Morphology**	**O_2 Require-ments**	**Commens-al**	**Reservoirs / Sites of colonization, Transmission**	**Types of Infections**
Staphylococci	Cocci in grape-like clusters	facultative anaerobe	Yes	Skin, nares / endogenous, direct contact, aerosol	Soft tissue, bone, joint, endocarditis, food poisoning
Streptococci	Cocci in pairs, chains	facultative anaerobe	Some species	Oropharynx, skin / endogenous, direct contact, aerosol	Skin, pharyngitis, endocarditis, toxic shock
Pneumococci	Diplococci, lancet shaped	facultative anaerobe	±	Oropharynx, sinus / aerosol	Pneumonia, otitis, sinusitis, meningitis
Enterococci	Cocci in pairs, chains	facultative anaerobe	Yes	GI tract / endogenous, direct contact	UTI, GI, catheter-related infections
Bacilli	Rods, spore-forming	aerobic	±	Soil, air, water, animals / aerosol, contact	Anthrax, food poisoning, catheter-related infections
Clostridia	Rods, spore formers	anaerobic	Some species	GI tract, soil / Breach of skin, endogenous, ingestion	Tetanus, diarrhea, gas gangrene, botulism
Corynebac-terium	Rods, nonspore forming	facultative anaerobe	Some species	Skin	Catheter-related infections, diphtheria
Listeria	Rods, nonspore formers	facultative anaerobe	No	Animals, food products / Ingestion	Meningitis
Actinomyces	Irregular, filamentous, form sulfur granules	anaerobic	Yes	GI tract / endogenous	Skin, soft tissue

Gram Negative Bacteria					
Name	**Morphology**	**O_2 Requirements**	**Commensal**	**Reservoirs / Sites of colonization, Transmission**	**Types of Infections**
Enterobacteriaceae (*E. coli*, klebsiella, salmonella, shigella)	Rods	facultative anaerobe	Some species	GI tract, animals / Endogenous, fecal-oral	Diarrhea, urinary tract, food poisoning, sepsis
Bacteroides	Rods	anaerobic	Yes	GI tract / Endogenous	Abscesses, intraabdominal infections
Pseudomonas	Rods	aerobic	No	Water, soil / Endogenous, breach of skin barrier	Infections in immunocompromised hosts, Cystic Fibrosis
Vibrio (cholera)	Rods, curved shape	microaerophilic	No	Water / Contaminated food, water	Diarrhea
Campylobacter	Rods, curved shape	microaerophilic	No	Food / Ingestion of contaminated food	Diarrhea, Bacteremia
Legionella	Rods, poorly stained	microaerophilic	No	Water / Inhalation of aerosol	Pneumonia, febrile illness
Neisseria	Cocci, kidney-bean shaped	Microaerophilic	No (*N. meningitidis* sometimes)	Humans / Sexual , aerosol	Meningitis, pelvic inflammatory disease
Hemophilus	Coccobacillary - pleomorphic	facultative anaerobe	Some species	Respiratory tract / Endogenous, aerosol	Respiratory, sinusitis, otitis meningitis
Bartonella	Small, pleomorphic rods	aerobic / microaerophilic	No	Cats, fleas, lice / cat bites, lice or fleas?	Cat scratch disease, endocarditis, bacillary angiomatosis

Infection

Is the invasion of an organisms body tissues by disease- causing agent ,their multiplication and the reaction of host tissues to the infection agents and the toxins they produce.

Classification of infection:

1-Primary infection:initial infection with organism in host constitue primary infection.

2-Reinfection: subsequent infection by the same organism.

3-Focal infection: infection at localized sites like appendix and tonsil.

4-Secondary infection: when in a host whose resistance is lowered by preexisting infectious disease a new organism may set up an infection.

5-Cross infection: a patient suffering from a disease and new infection is set up from another host or external source.

6-Nasocomial infection:it's cross infection occurring in hospital.

7-Subclinical infection: is one where clinical effects are not apparent.

Source of infection in man:

1- **Man** → a- patient

→ b- carrier

2- **Animals** - zoonosis

3- **Insects** - arthropod borne disease

4- **Soil** – round worm, hook worm, spores.

5- **Water**-cholera ,...

6- **Food**- food poisoning.....

7- **Vectormalaria**....

Methods of transmission of infection:

1- **Contact** – syphilis,gonorrhea.

2- **Inhalation** – influenza,tuberculosis, small pox.

3- **Infection** – cholera (water) , food poisoning (food) .

4- **Inoculation** – tetanus (infection) , rabies (dog) , serum hepatitis (injection) , arbovirus (insects) .

5- **Insects**– mechanical vector (dysentery and typhoid by house fly) or biological vector (malaria by sundfly) .

6- **Congenital** – syphilis,rubella.

7- **Laboratory infection** – injection, catheterization …..

Staphylococcus

General characters:

They are GP Cocci , ovoid or spheroid , non motile arranged in groups on nutrient agar they are form colonies white , yellow, or golden yellow in color .

Pathogenic strains produce – coagulase , ferment sugar (giucose, lactose , manitol) with acid production , liquefy gelatin and produce pus in lesion .

Classification

a- On the basis of pigment production (3) types of *Staph.* are dentified :-

1- *Staph. aureus* : produce golden yellow colonies .

2- *Staph. albus* : produce white colonies .

3- *Staph. citreus* : produce lemon yellow colonies .

b- On the basis of pathogenicity :-

1- Pathogenic species – *Staph . aureus (pyogenes)*

2- Non pathogenic spp. – *Staph . epidermides*

Staph aureus (pyogenes)

a- Morphology:

they are ovoid, non motile, non capsulated,none sporing and GP. They are arranged in cluster. Golden yellow in color on N.A.pigment production occurs at (22C°) and only in aerobic culture and the pigment is lipoprotein.

Factors in influencing pigment production:-

1- Temperature – (20-25C°).

2- Oxygen – aerobic.

3- Medium – on solid medium.

4-light; in presence of light pigmentation of colony is better.

C-Characteristic

Gram-positive cocci in cluster, coagulase positive, catalase-positive.

D-Habitat and

Habitat is human skin and nose. Transmission is via the hands

E-Laboratory

Gram stained smear and culture yellow or gold .Colonies on blood agar.

Staph.aureus is coagulase –positive& API .

*Staph.Epidermidis*is coagulase –negative. Serologic test not useful.

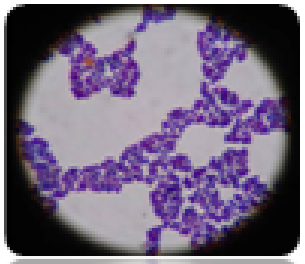
Pathogenecity:

1-cutaneous lesions: boils, abscess, impetigo……

2- Deep infection :acute osteomyelitis, pharyngitis, sinusitis, pneumonia, mengitis, endocarditis and renal abscess, staph, Septicemia is rare but serious disease

3-food poisoning

Streptococcus



-**Characteristic:-**Gram-positive cocci in chain, beta hemolytic, catalase – negative non motile, none sporing

Classification of *Streptococcus*

1-Morphological classification:

A-long chain → pathogenic strain.

B-short chain → non- pathogenic strain

2- Classification based on culture

A-Obligate anaerobe.

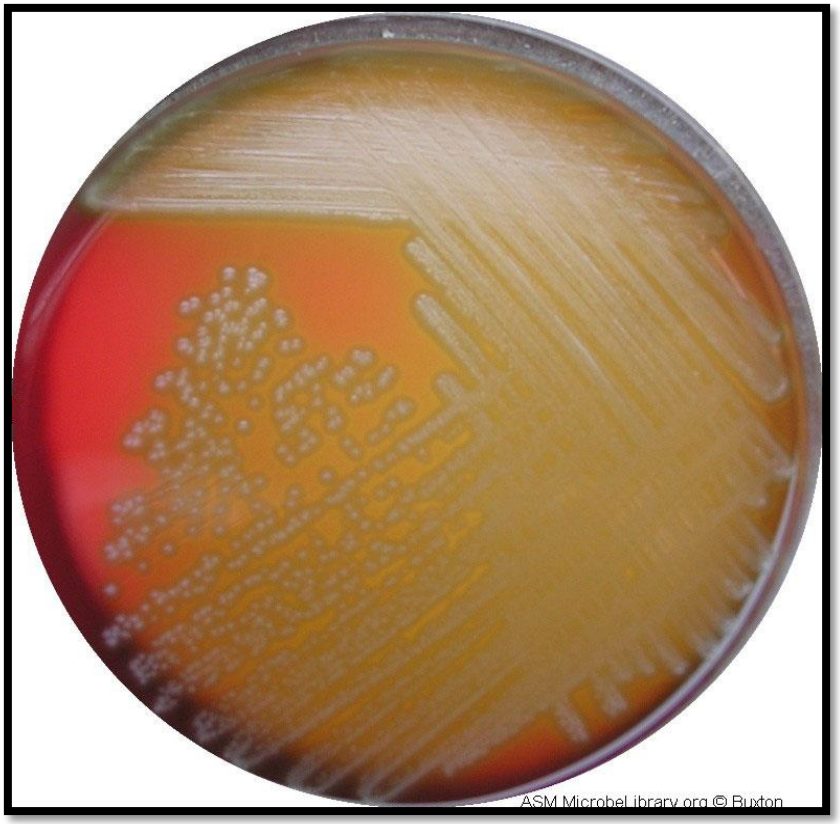
B-Aerobes.

C-Facultative anaerobe.

-The aerobic or facultative *strep.* Are classified on the base of hemolytic property in the blood agar plate:

a- **Alfa hemolytic**-*Strep.*_**:**Produced a zone of greenish colour around the colony due to partial lysis of RBC.

b- **Beta hemolytic**-*Strep.*: Produced sharply defined clear colorless zone of hemolytic due to complete lysis of RBC.



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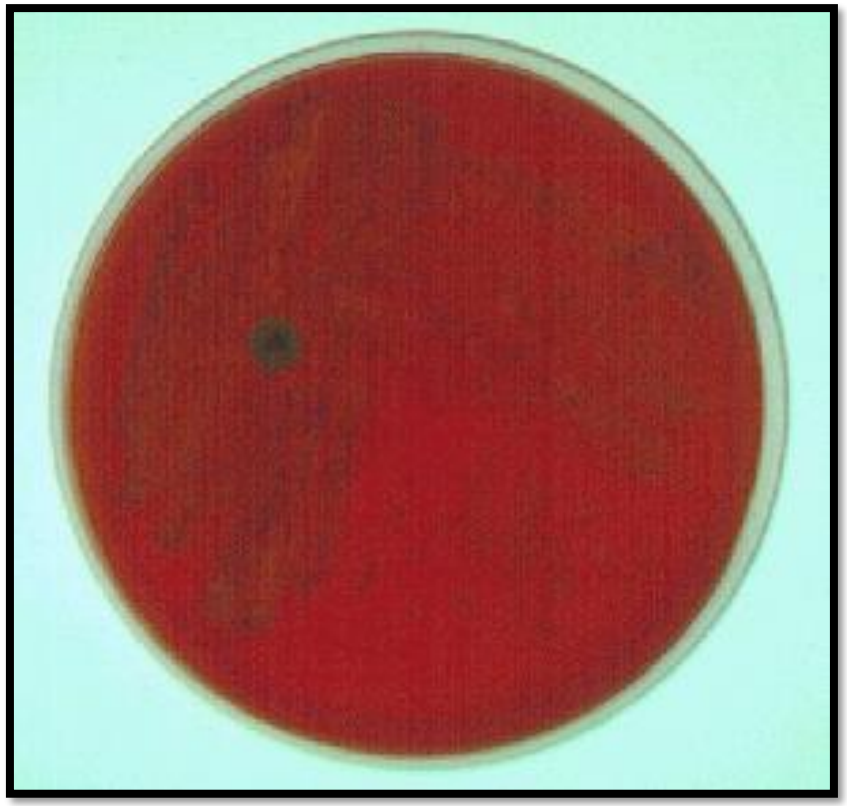
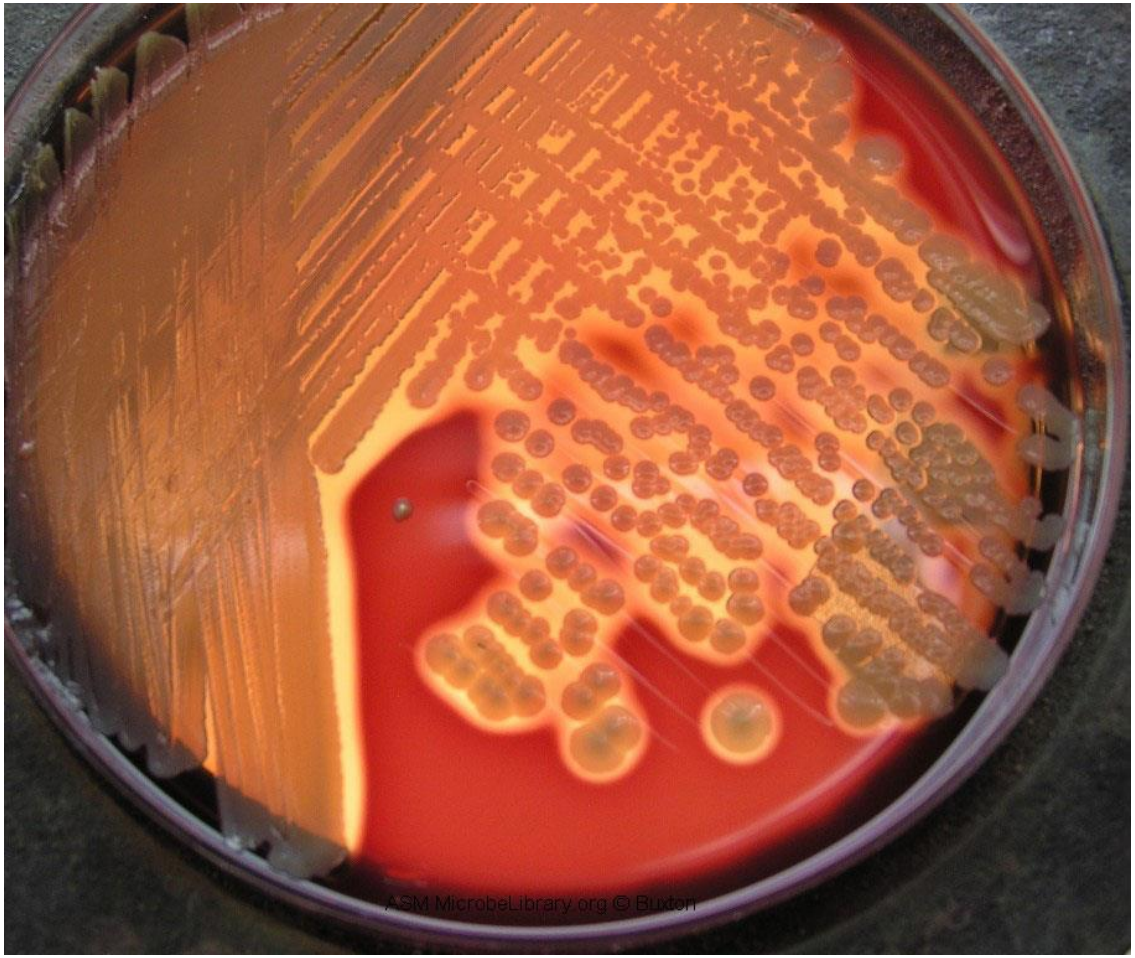


Gamma



Beta

c- **Gammahemolytic-**: *no* change on blood agar, nohemolytic of RBC.

3-Classification based on biochemical

Mannitol is fermented by enterococci.

Strep.pyogenes }
Strep.viridians } not ferment mannitol.

4-Classification based

A, b,……, u.

Streptococcuspyogenes(group A)

A-Characteristic-Gram-positive cocci in chains , beta hemolytic, catalase -negative ,non motile , non sporing , they are usually an capsulated ,it is composed of hyaluronic acid .

B-Habitat and transmission:-

habitats is the human throat and skin.

Transmission is via respiratory droplets.

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C-Pathogenesis:

Respiratory infection: sore throat, tonsillitis, pharyngitis, otitis media.

Scarlet fever: is caused by a strain producing erythrogenic toxin and characteristic erythematuous rash.

a- Skin infection: wound, burns, and cellulites.

b- Genital tract infection :- puerperal sepsis (nasophraynx of doctors and nurses are the source of infection.

d-other infection :-abscess of organ (brain, lungs, liver, kidney).it may cause septicemia.

D-Non suppurative complications:

A-acute rheumatic fever.

B-acute glomerulonephritis.

E-Laboratory diagnosis:-

Gram stained smear and culture, beta hemolytic colonies on blood agar (hemolysis due to streptolysins O and S). If isolate is sensitive to bacitracin, it is identified as *Strep.pyogenes*.

Patient antistreptolysin o (ASO) antibody titer is tested to determine prior exposure to *Strep.pyogenes*. If rheumatic fever is suspected.

Streptococcus pneumoniae

(pneumococcus)

The pneumococcus are Gram positive diplococci , lancet shaped or arranged in chains , capsulated (polysaccharide) .

Pneumococcus are normal inhibit ants of the upper respiratory tract of humans and can cause : pneumonia , sinusitis , otitis , bronchitis , bacteremia , meningitis , and other .

Culture: Pneumococci form small round colony , at first dome- shape , later developing a central plateau with elevated rim , alpha hemolysis on blood agar , growth is enhanced by 5 – 10 %CO2.

Lab. Diagnosis:

Blood is drawn for culture and sputum is collected for demonstration of *pneu.* by smear and culture.

GRAM POSITIVE BACILLI

Corynebacterium diphtheria

- **Morphology**:-they are GPB non acid fast &non motile bacilli,showing clubbing at one or both ends, non spoing &non capsulated. The presence of metachromatic granules (Babes-Ernst) granules serve to distinguishit from diphtheroid.the granules are colored dark purple with mehtylene blue ,Albert or Neissers stain.

  The granules consistof polymerized metaphosphate.the bacilli seen in chine's letter arrangement this is due to incomplete separation of daughter cell after binary fission.

biochemical reaction;

- They are ferment glucose and maltose with acid production
- Catalase → positive.
- Oxidase → negative.
- Don't liquefy gelatine .
- Urea is not hydrolysed.

Resistance:-

-It is destroyed by heat (58C° for 10 min).

-It is sensitive to penicillin, erythromycin &broad spectrum antibiotics.

-It is resistant to drying.

Toxin:-

Diphtheria produce very powerful exotoxin .

The toxin consist of 2 factors a & b.

a-Is a lethal factor.

b-Is a spreading factor.

Diphtheria toxin is protein in nature. It can be converted in to toxoid [toxin that has lost toxicity but not antigenecity] by:-

1-Prolonged storage at 37C°

2- Incubation at 37C° for 4-6 weeks.

3- 0.2 -0.4 % formalin.

The mechanism of action of toxin is inhibits protein synthesis & rapidly kill susceptible cell .it has affinity for myocardium, adrenal tissue & nerve endings.

★ **Pathogenecity:-**

Incubation period is 3-4 days. The site of infection may be:-

1-facial 2-laryngeal 3-nasal 4- otitis 5-conjunctiva 6 - Cutananeous around mouth & nose. 7-Genital →vulual,vaginal.

★ **Immunity:**

-**Passive immunity**:-this is an emergency measure when susceptible are exposed to infection.

(500-1ooo unites) of antitoxin (anti diphtheria serum) is give subcutaneously.

-Active immunity:-

-Schick's test: -


I'M HERE FOR YOU

Infection

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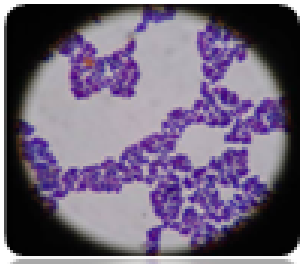

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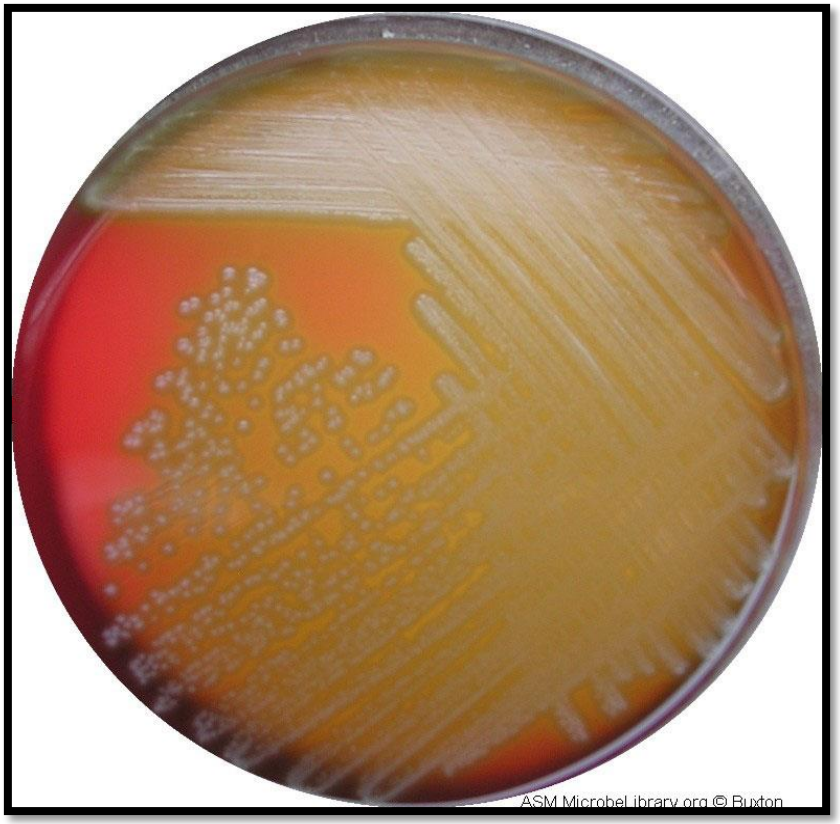

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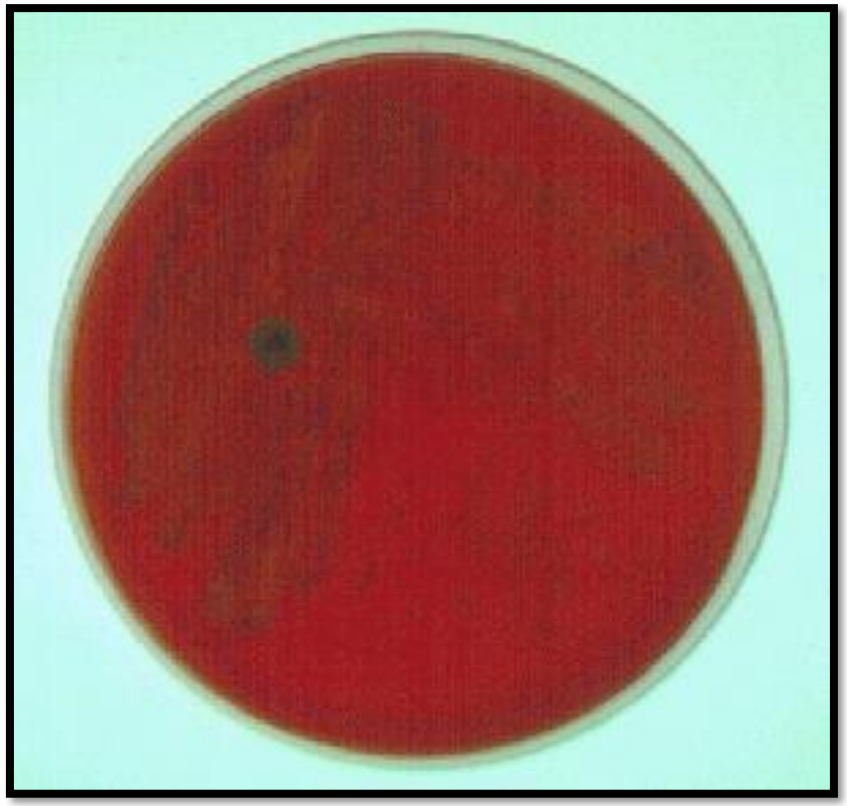
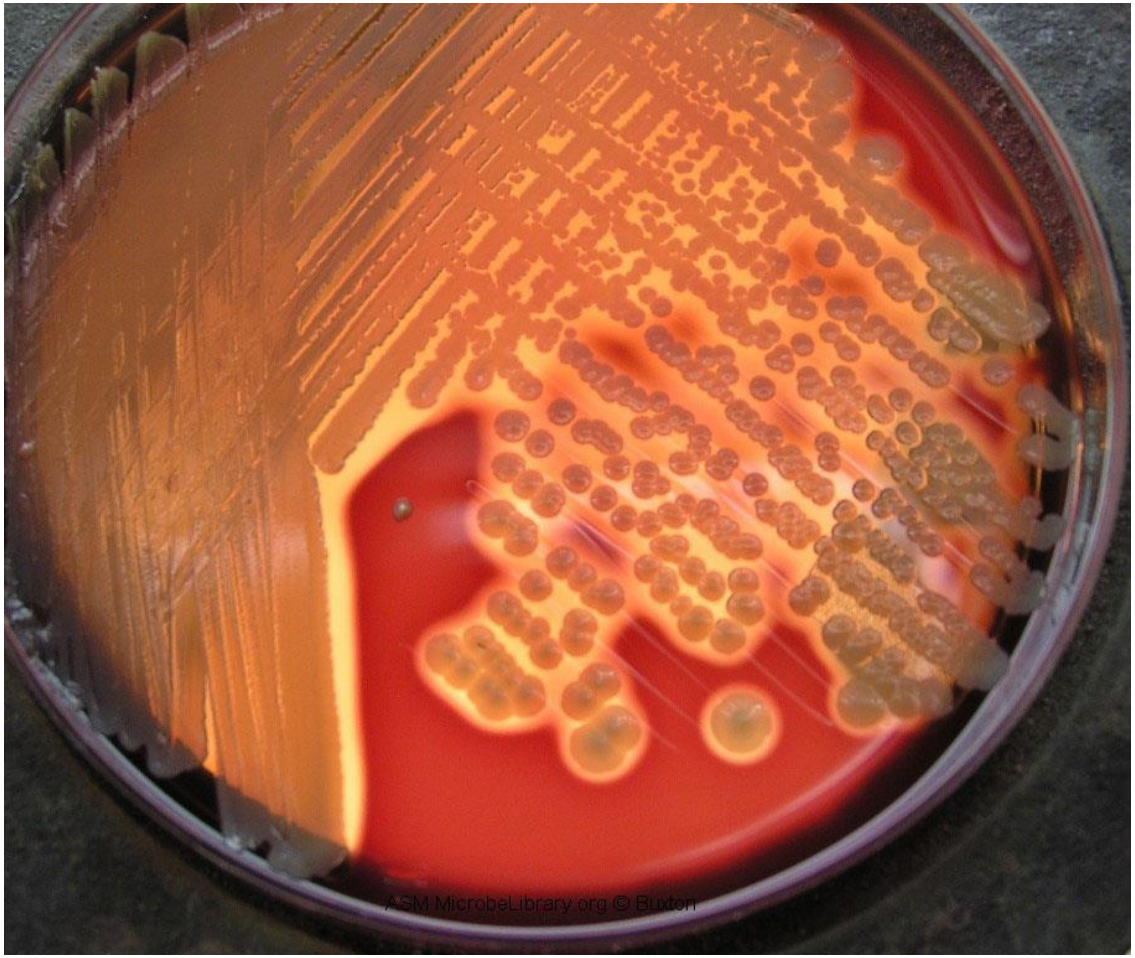


Gamma



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Culture: Pneumococci form small round colony , at first dome- shape , later developing a central plateau with elevated rim , alpha hemolysis on blood agar , growth is enhanced by 5 – 10 %CO2.

Lab. Diagnosis:

Blood is drawn for culture and sputum is collected for demonstration of *pneu.* by smear and culture.

GRAM POSITIVE BACILLI

Corynebacterium diphtheria

- **Morphology**:-they are GPB non acid fast &non motile bacilli,showing clubbing at one or both ends, non spoing &non capsulated. The presence of metachromatic granules (Babes-Ernst) granules serve to distinguishit from diphtheroid.the granules are colored dark purple with mehtylene blue ,Albert or Neissers stain.

  The granules consistof polymerized metaphosphate.the bacilli seen in chine's letter arrangement this is due to incomplete separation of daughter cell after binary fission.

biochemical reaction;

- They are ferment glucose and maltose with acid production
- Catalase → positive.
- Oxidase → negative.
- Don't liquefy gelatine .
- Urea is not hydrolysed.

Resistance:-

-It is destroyed by heat (58C° for 10 min).

-It is sensitive to penicillin, erythromycin &broad spectrum antibiotics.

-It is resistant to drying.

Toxin:-

Diphtheria produce very powerful exotoxin .

The toxin consist of 2 factors a & b.

a-Is a lethal factor.

b-Is a spreading factor.

Diphtheria toxin is protein in nature. It can be converted in to toxoid [toxin that has lost toxicity but not antigenecity] by:-

1-Prolonged storage at 37C°

2- Incubation at 37C° for 4-6 weeks.

3- 0.2 -0.4 % formalin.

The mechanism of action of toxin is inhibits protein synthesis & rapidly kill susceptible cell .it has affinity for myocardium, adrenal tissue & nerve endings.

★ **Pathogenecity:-**

Incubation period is 3-4 days. The site of infection may be:-

1-facial 2-laryngeal 3-nasal 4- otitis 5-conjunctiva 6 - Cutananeous around mouth & nose. 7-Genital →vulual,vaginal.

★ **Immunity:**

-**Passive immunity**:-this is an emergency measure when susceptible are exposed to infection.

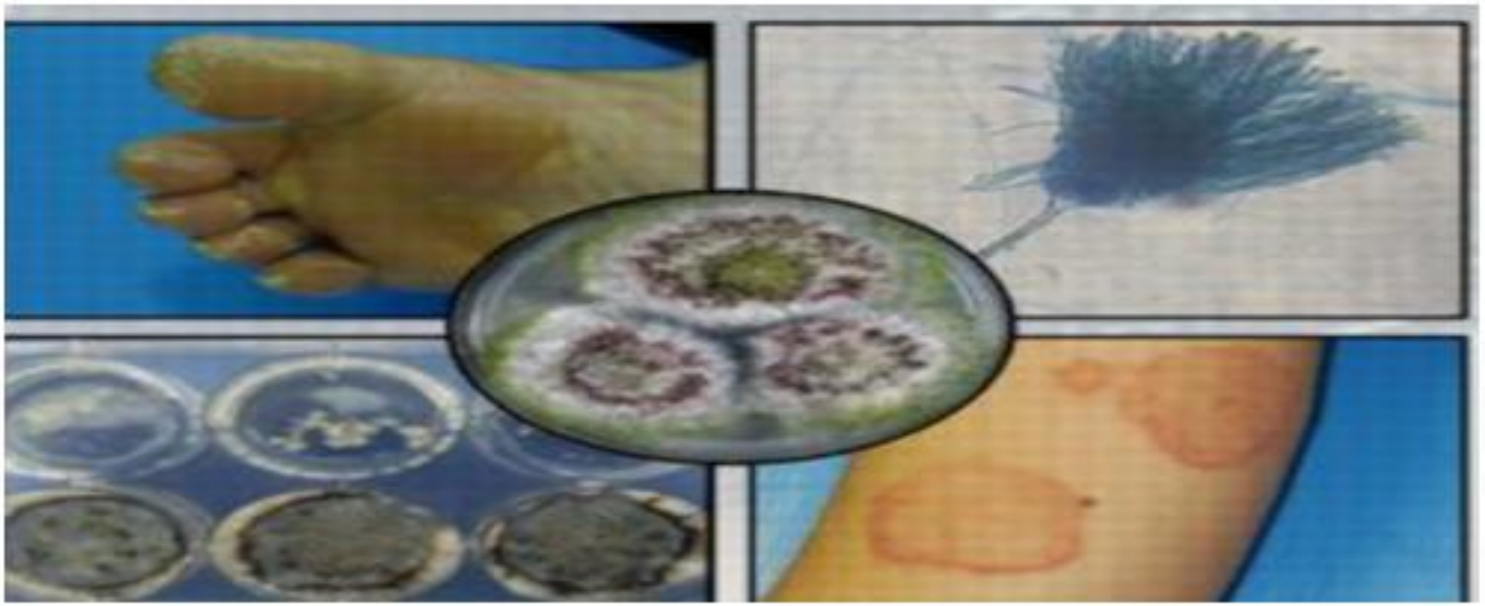
(500-1ooo unites) of antitoxin (anti diphtheria serum) is give subcutaneously.

-Active immunity:-

-Schick's test: -


I'M HERE FOR YOU

The mycology:



The fungi :

Are eukaryotic, mostly saprophytic m.o . The majority are facultative parasites able to utilize live or dead organic matters . Some species can survive only on living cells (obligatory parasites) ,that causing the diseases of man, animals & plants.

The fungi grow either :-

1- Single cells ⟶ yeasts

2- multi cellular filamentous colonies ⟶ moulds & mushrooms

The fungi are differ from bacteria by :

1. have true nucleus .
2. have mitochondria & endoplasmic reticulum .
3. have sterol in cytoplasmic membrane as higher plants & animals .

The fungi can be The fungi can be reproduce

A- asexual by :

1. budding ⟶ yeasts
2. spores ⟶ conidiospores
3. fragmentation of hyphae
4. fission of yeasts

B- sexual by spores derived from union of two gametes (♀ & ♂)

or two nuclei as :

1. zygospores
2. ascospores
3. basidiospores

The fungi are important in industry in :

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or two nuclei as :

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2. ascospores
3. basidiospores

The fungi are important in industry in :

1. **production of antibiotics .**
2. **= = beer & wines.**
3. **making of breads & cheeses .**

The pathogenic fungi :

1. **Cutaneous mycoses (dermato mycoses)**

- ★ ***Dermatophyton*** ⟶ **infect skin, hair & nails.**
- ★ ***Microsporum*** ⟶ **infect skin & hair .**
- ★ ***Epidermophyton*** ⟶ **infect skin & nails .**

All these fungi have ability to invade & parasitized the cornified tissues , digest & utilized the keratin & cause infection of epidermis & its appendages (hair , nails & others) in man & animals which is called ring worm or tinea

The treatement :

1. **Oral administration of griseofulvin :**
   - **for 10 days in skin infection**
   - **for 3-4 weeks in hair inf.**
   - **for several months in horny skin**
   - **for one year or more in nails**
2. **Surgical remove of infected tissues (hair & nails)**
3. **Topical application of antifungal as:**

★ **lotion** ⟶ **clotrimazole**

★ointment ⟶ tolnaftate

2.Subcutaneous mycoses :

1- Phialophora

2- Cladosporium

3-Sporothrix

The infection occur by penetration of skin within contaminated objects ⟶ ulceration ⟶ formation of nodules & abscesses. The infection can be spread to adjacent tissues or to far tissues through lymphatic vessels .

The treatment :

1. **Surgical drainage of nodules & abscesses.**
2. **Systemic treatment with antifungal drugs.**

3. Systemic mycoses :

★ ***Histoplasma*** ⟶ **histoplasmosis (like pulmonary T.B)**

★ ***Blastomyces dermatitidis*** ⟶ **blastomycosis :**

1. cutaneous form

2. pulmonary form

3. general or systemic form

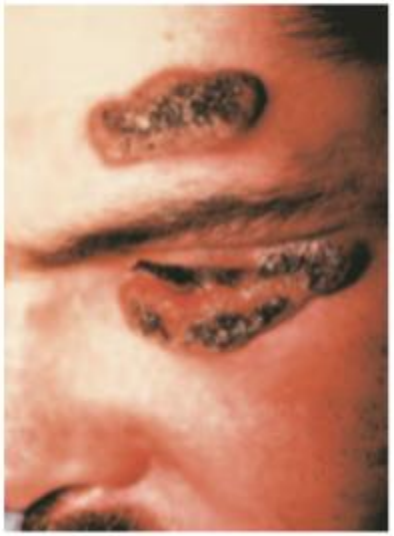
★ ***Coccidioides immitis*** ⟶ **coccidioidomycosis**

1. benign ⟶ pulmonary form

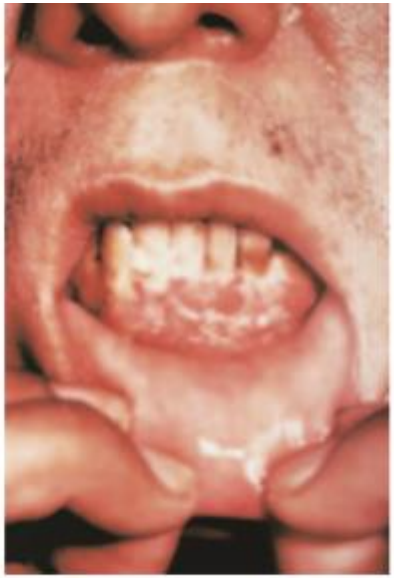
2. malignant ⟶ systemic form , infect skin , subcutaneous tissues, internal viscera & bones.

★ ***Paracoccidioides*** ⟶ **paracoccidioidomycosis is chronic disease infect oral mucous membrane, skin, lymph node & internal viscera**

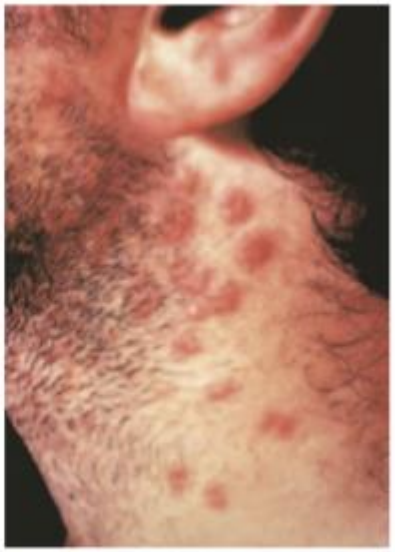
Blastomycosis



Cutaneous blastomycosis.



Mucosal ulcer in a patient with histoplasmosis.



Erythema multiforma in a patient with primary pulmonary coccidioidomycosis.

I

The treatment :

1. Amphotericin B (fungizone) intravenous twice weekly is drug of choice , has wide spectrum activity against most pathogenic fungi . Depending on the disease ,the treatment may be extend for several months.

2. Miconazole orally or I.V

The opportunistic pathogenic fungi

Are saprophytic fungi cause the diseases when the host's resistance is lowered as in :

1. malignancies.

2. diabetes mellitus.

3. pregnancy.

4. immunosuppressive therapy.

5. using broad spectrum antibiotics.

6. extensive burns & injuries.

Examples of these fungi :

Candida albicans

is normal flora of oral mucous membrane, digestive system & vagina causing candidiasis of mouth (thrush) in infants , also candidiasis skin & intestine & vulvovaginitis in female.

★ *Cryptococcus* infect brain ,meninges, lung & skin.

★ *Aspergillus fumigatus* cause aspergillosis which is chron hypersensitivity pneumonia , asthma & rhinitis

★ *Mucor sp.* cause infection of lung , mucous membrane of oropharynx & nose & subcutaneous tissue

The treatment :

A-for thrush :

1. gention violet (1%)
2. nystatin as drops

B- for cutaneous lesion :

1. para hydroxy benzoic acid as cream or ointment(locally)
2. miconazole as cream (locally)

C- for vaginal & other local lesions :

1. nystatin as cream or ointment (locally)
2. miconazole as suppository or cream

- for visceral infection :

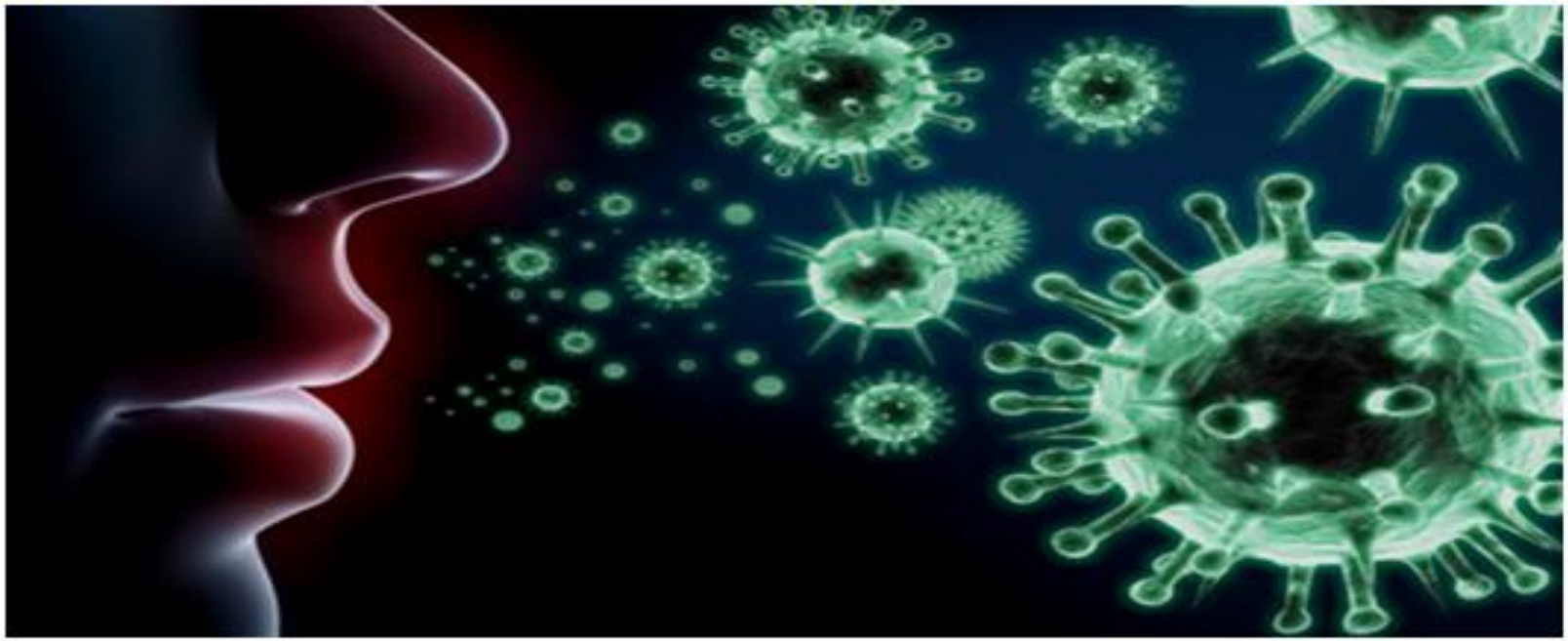
systemic antifungal drug as amphotericin B (I.V)

miconazole (orally or I.V)


I'M HERE FOR YOU

The Virology

The virus :



is the smallest infectious agents (20 –300 nm in diameter). Obligatory intracellular m.o containing one type of nucleic acid either

general properties of the virus :

A. The size:

are very small m.o ,measured with nanometer therefore must be used electron microscope for resolution of the viruses.

B. The structure :

The virus particle is composed of :

1- core of genome either DNA or RNA , therefore the viruses are classified into :

DNA viruses & RNA viruses . This genome is important in encoded the information about multiplication of the viruses.

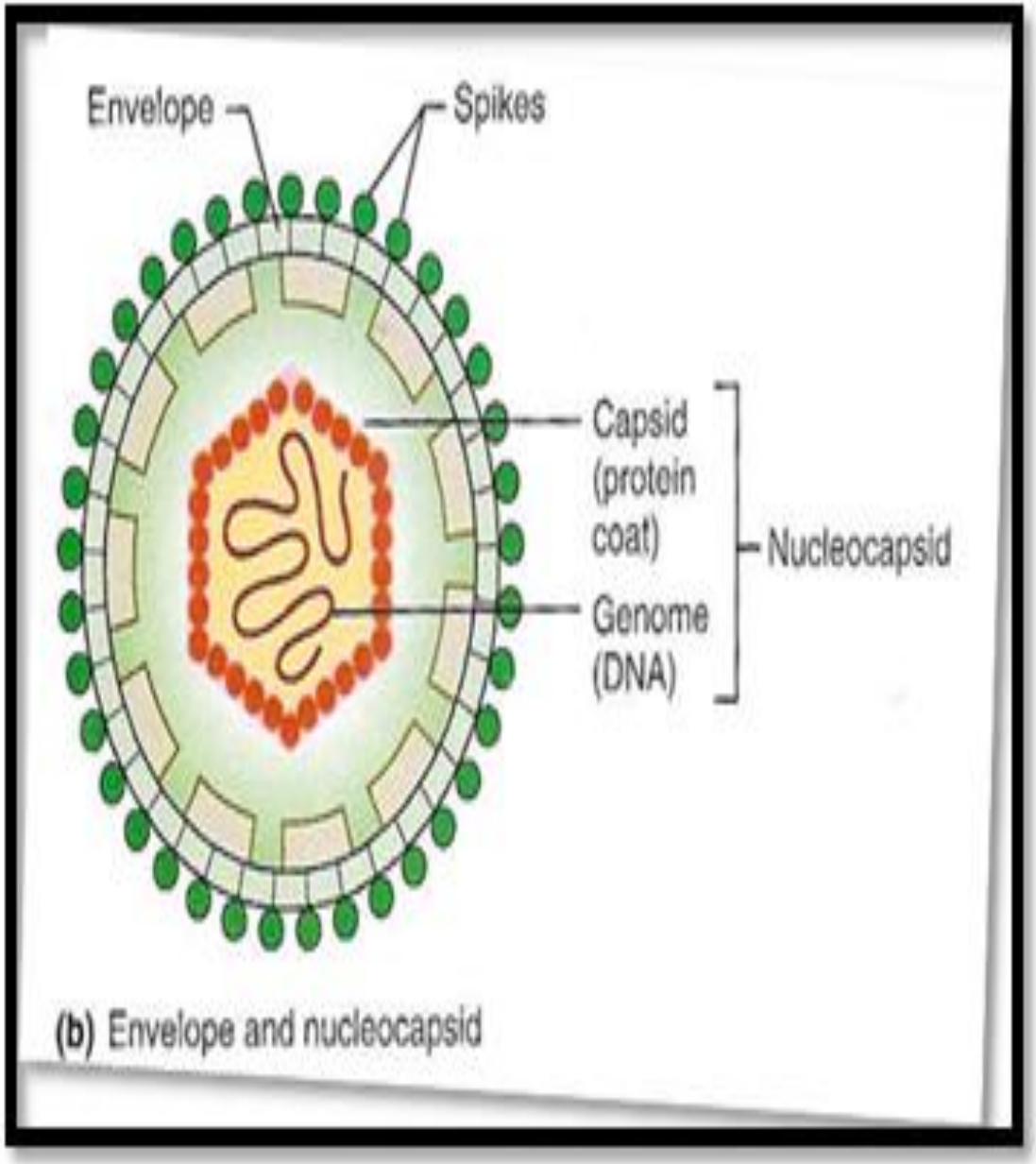
2- protein coat (capsid) : which composed of large numbers of capsomers . The main functions of it are :

a. protect the viral genome from destruction by agents found in extra cellular environment as tissue nuclease enzyme .

b. play important role in attachment viruses to receptors on susceptible cells.

3- in some viruses (animal viruses) the protein coat is surrounded by lipoprotein envelope which is acquired from cytoplasmic membrane or nucleic membrane of the host cell, have functions as capsid .

The complete virus particle is known as virion , an infective unit


Envelope
Spikes
Capsid (protein coat)
Genome (DNA)
Nucleocapsid
(b) Envelope and nucleocapsid

Examples of RNA viruses :

1- Influenza virus ⟶ influenza

2- paramyxoviruses : mump v. ⟶ mump

measle v. ⟶ measles

rubella v. ⟶ rubella

3- Rhabdoviruses → rabies

4- Picorna virus → poliomyelitis

5- Toga virus → yellow fever

6- Retrovirus → AIDS

7- Hepatitis A virus → hepatitis

Examples of DNA viruses:

1- Pox viruses : variola v. → small pox

vaccinia v. → cow pox

2- Adenoviruses → upper respiratory tract infection

3- Herpes simplex virus → inf.of oral mucous membrane

4- Hepatitis B virus → hepatitis

Multiplication of human viruses:

The steps of multiplication include :

1.Adsorption between viral capsid & specific receptors on susceptible host cell.

2.Penetration & un coating :

a- Virion without envelope ⟶ engulfed by infected cell

b-Virion with envelope ⟶ the lipid envelope is combined with cytoplasmic membrane of host cell ⟶ the nucleocapsid is engulfed by infected cell ⟶

remove of the capsid ⟶ releasing of genome in cytoplasm of infected cell .

3. Vegetative growth: by using protein synthesis system & energy sources of infected cell for replication of new viral particles .

4. Maturation & release : for infect another cells.

Effect of chemo sterilants & antiviral drugs:

The viruses with lipid envelope are inactivated by organic solvents as : chloroform , ether compared with viruses without this envelope .

Other chemical agents have virucidal effect are : chlorine , iodine , hypochlorite , aldehydes & ethylene oxide .

There are limits in selection of chemotherapeutic agents in viral infection due to :

1. Dependence of viruses on energy & protein producing systems of the host cell .

2. The viral diseases become apparent after extensive viral multiplication & tissue damage has been done .

Recently there are several antiviral drugs as:

1. antiviral that prevent the adsorption of viral particles to the host cell.
2. antiviral that prevent intracellular penetration of the adsorbed viruses as : amantadine hydrochloride
3. antiviral that inhibit the protein or nucleic acid synthesis as:

- Idoxoridin
- Methisazone against DNA viruses (Vaccinia &Variola V.)
- Vidarabine against DNA viruses (Herpes & Pox V.)
- Ribavirin is broad spectrum antiviral drug against DNA & RNA viruses.


THANK YOU

Antibodies and Antigens

Antibodies may be defined as the proteins that recognize and neutralize any microbial toxin or foreign substance such as bacteria and viruses. The only cells that make antibodies are B lymphocytes. Mainly two forms of antibodies exist. One those that are membrane-bound and act as receptor for antigens on the surface of B lymphocytes and the other that are involved in inhibition of entry and spread of pathogens and are found in blood circulation and connective tissues. The substance or molecule identified by antibodies or that can evoke antibody response is called an **antigen**.

Some commonly used terminologies

Serum – Clot formation in the blood leaves the residual fluid that contains antibodies. These antibodies in the residue form the serum.

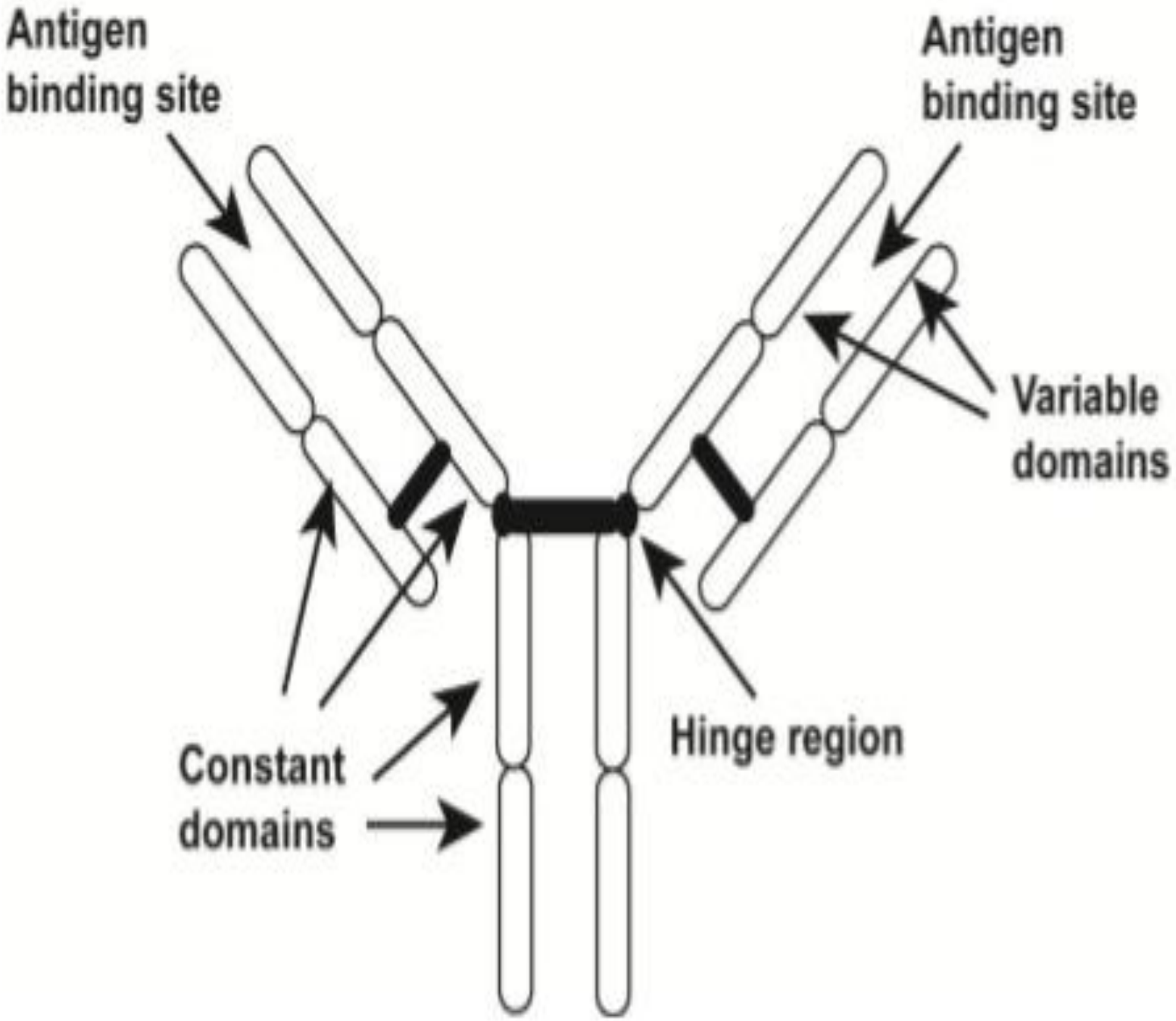
Antiserum – Serum contains a bunch of antibodies and when these antibodies show specificity to a particular antigen by binding to it, those antibodies are known as antiserum.

Serology- Serology may be defined as the study of blood serum or antibodies and their reactions with particular antigens.

Antibody structure

Antibodies are also called as **immunoglobulins** and are Y- shaped protein structures. Antibodies consist of two identical light and heavy chains. Amino terminal variable (V) regions are found in both heavy and light chains and they take part in antigen recognition. Effector functions are directed by carboxy – terminal constant (C) regions of the heavy chains but C regions are also found in both the chains. Both the heavy and light chains are composed of Immunoglobulin (Ig) domain. Ig domain is a protein domain that consists of folded repeating units of 110 amino acids in length sandwiched between two layers of β-pleated sheet. The two layers of β–pleated sheet are held together by a disulfide bridge and there are short loops that connect the adjoining strands of each β sheet. Amino acids in some of these loops are most crucial for antigen recognition. Light and heavy chain structure is almost similar. In light chain there is one V region Ig domain and one C region Ig domain whereas in heavy chain V region comprises of one Ig domain

and the C region comprises of three or four Ig domains. Antigen-binding site is formed by the V region of one heavy chain and the adjacent V region of one light chain. Disulfide bonds formed between cysteine residues connect the light and heavy chains in the carboxyl terminus of the light chain and the CH-1 domain of the heavy chain. Association of heavy and light chains occurs partly due to the non-covalent interactions between the VL and VH domains and between the CL and CH1 domains. Two heavy chains of each antibody entity are connected covalently by disulfide bonds. In IgG antibodies disulfide bonds are formed between cysteine residues in the CH2 regions which are near to a region known as **hinge**. This hinge region is more likely to undergo proteolytic cleavage. **Fragment antigen binding** (Fab fragment) is a portion on antibody that has the capability to bind to antigen and consists of one variable and one constant domain of each of the heavy and the light chain. **Fragment crystallizable region** (Fc region) is the distal region of an antibody that is composed of two identical, disulfide linked peptides containing the heavy chain CH2 and CH3 domains. Fc region communicates with some cell surface receptors called Fc receptors and this feature of Fc region helps antibodies to stimulate the immune system.


Antigen
binding site
Antigen
binding site
Variable
domains
Constant
domains
Hinge region

THE NATURE OF ANTIGENS

- Antigen
  - Molecule which can bind to specific antibody but cannot eli
    adaptive immune response
- Immunogen
  - Molecule which can stimulate adaptive immune response

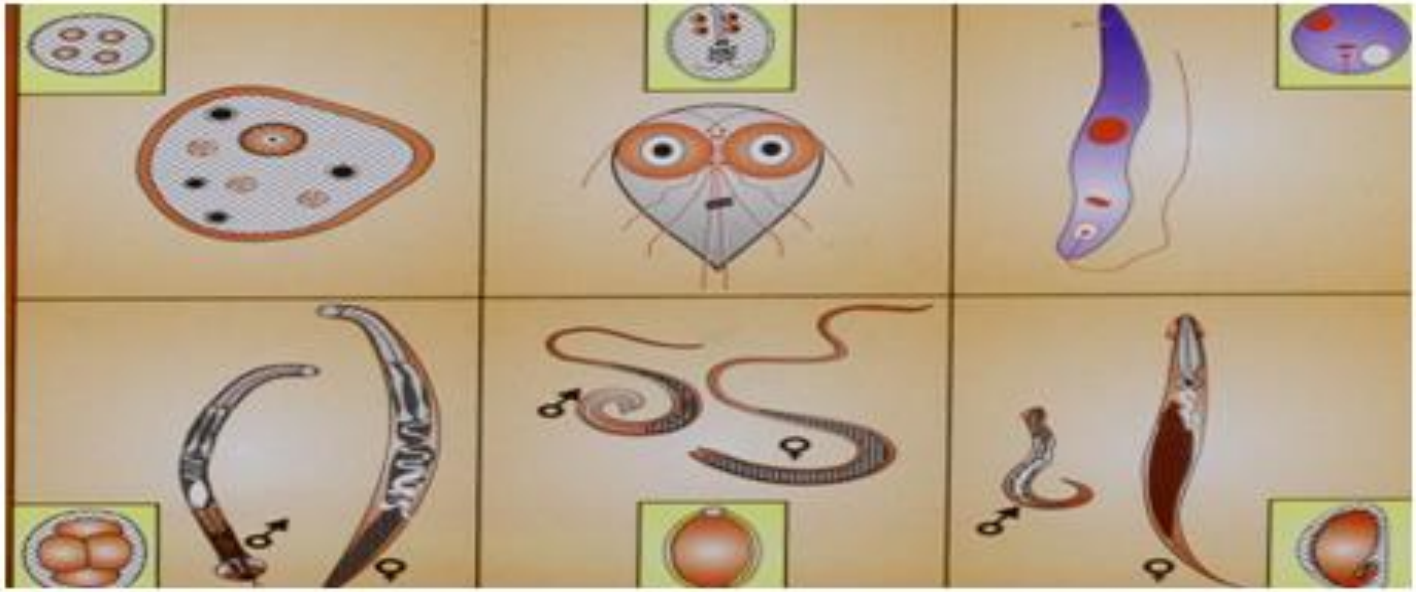
- Best immunogens are proteins with MW > 10,000
- Carbohydrates, nucleic acids and lipids are also potential antigens / immunogens
- Hapten
  - Small (low MW) molecule unable to elicit immune response

CLASSIFICATION OF ANTIBODIES (IMMUNOGLOBULINS)

- Five (5) classes (isotypes)
  - Immunoglobulin A (IgA)
  - Immunoglobulin G (IgG)
  - Immunoglobulin M (IgM)
  - Immunoglobulin D (IgD)
  - Immunoglobulin E (IgE)


THINK OF YOU

Medical Parasitology : The Protozoa



The Medical Parasitology :

The parasitism

Is the relationship between two organisms , the 1st. is called the parasite & the 2nd. is the host.

The parasitemia

Is presence of parasites in the blood of vertebrate hosts , as in infestation with Plasmodium sp.

The final host

The parasites found in this host in mature stage .

The intermediate host

Parasites found in this host in immature stage.

The vector

Is insect or arthropod which transfer the parasites to human or animal .

Infective stage

Is the stage of parasites that cause the disease .

Habitat : 

Is the location of parasites inside the host body

* The medical parasitology include : Protozoa , Helminthes & Arthropods

The protozoa

Are single cell animals in which one cell is capable of performing all necessary functions , with (5- 50) in dimensions .

The protozoa include the following groups :

1. **Sarcodina** : Typically amoeboid organisms (moved by pseudopodia), reproduce asexually by binary fission . Example : *Entamoeba* (gut parasite)

2. **Mastigophora** : The organisms are moved by flagella , reproduce asexually by binary fission . Example :

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1. **Sarcodina** : Typically amoeboid organisms (moved by pseudopodia), reproduce asexually by binary fission . Example : *Entamoeba* (gut parasite)

2. **Mastigophora** : The organisms are moved by flagella , reproduce asexually by binary fission . Example **:**

A- Intestinal flagellates ⟶ *Giardia*

B - Genito urinary tract flagellates ⟶ *Trichomonas*

C- Blood & tissue flagellates ⟶ *Leishmania* & *Trypanosoma*

3. **Sporozoa** : Organisms with restricted motility , reproduce sexually & asexually. Example: *Plasmodium* & *Toxoplasma* (tissue parasites)

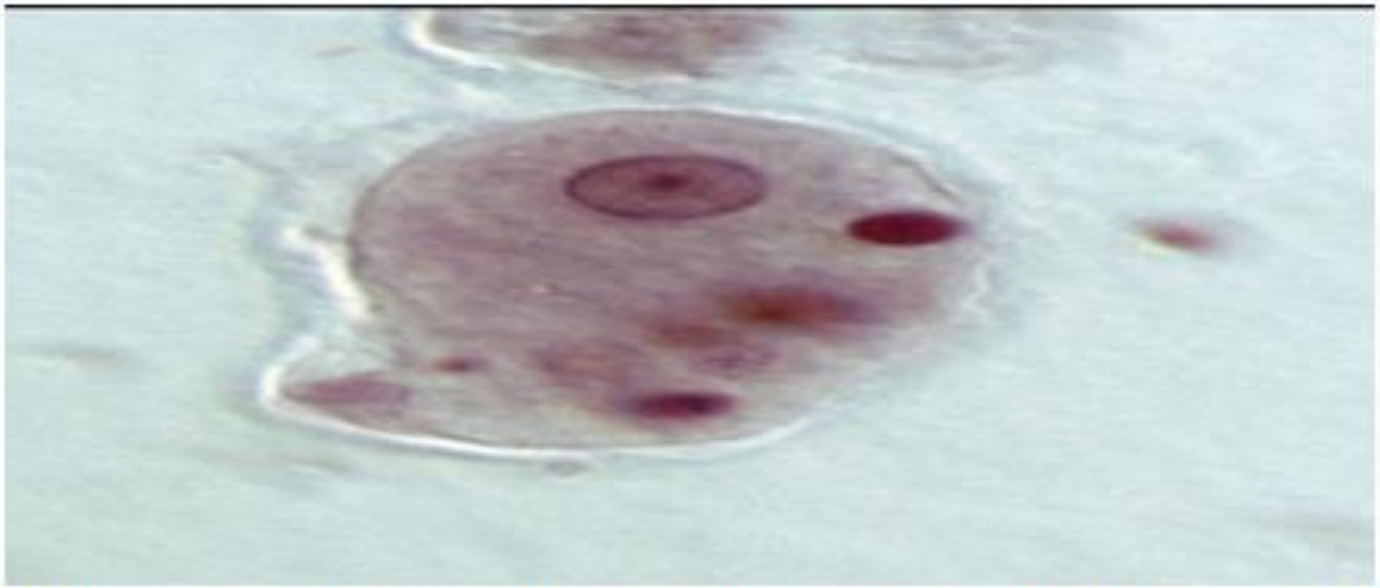
4. **Ciliophora**: Organisms moved by cilia , reproduce sexually & asexually . Example : *Balantidium* (gut parasites).

Gut parasites

Class: ***Sarcodina***

Genus: ***Entamoeba***

Sp.: ***Ent. Histolytica***



Is the pathogenic sp. cause amobiasis (amoebic dysentery) for human.

The life cycle is consist of :

- **Trophozoites**
- **Cysts**

The trophozoites may be :

1. **found in lumen of large intestine .**
2. **invade the mucosa of large intestine using proteolytic enzymes &produce ulcers which cause bloody diarrhea.**
3. **undergo encystations.**

The infective stage ⟶ cysts

The infestation occur by ingestion of contaminated drinks & food specially vegetables & fruits fertilized with human feces .

The *Ent. histolytica* maymbe spread out of intestine via blood & lymphatic circulation or direct extension to :

1.liver mainly & cause amoebic hepatitis

2.other organs as :

a -Thoracic cavity (pleura , lung , pericardium)

b - Spleen , urinary bladder, cervix , vagina & prostate

c- Skin

d - brain

The treatment :

1. metronidazole (flagyl) is drug of choice (orally)

2. for treatment of acute & chronic intestinal amoebiasis or hepatic &

3. other extra intestinal amoebiasis : metronidazole + diloxanide furate (furamide) followed by chloroquin (aralen)

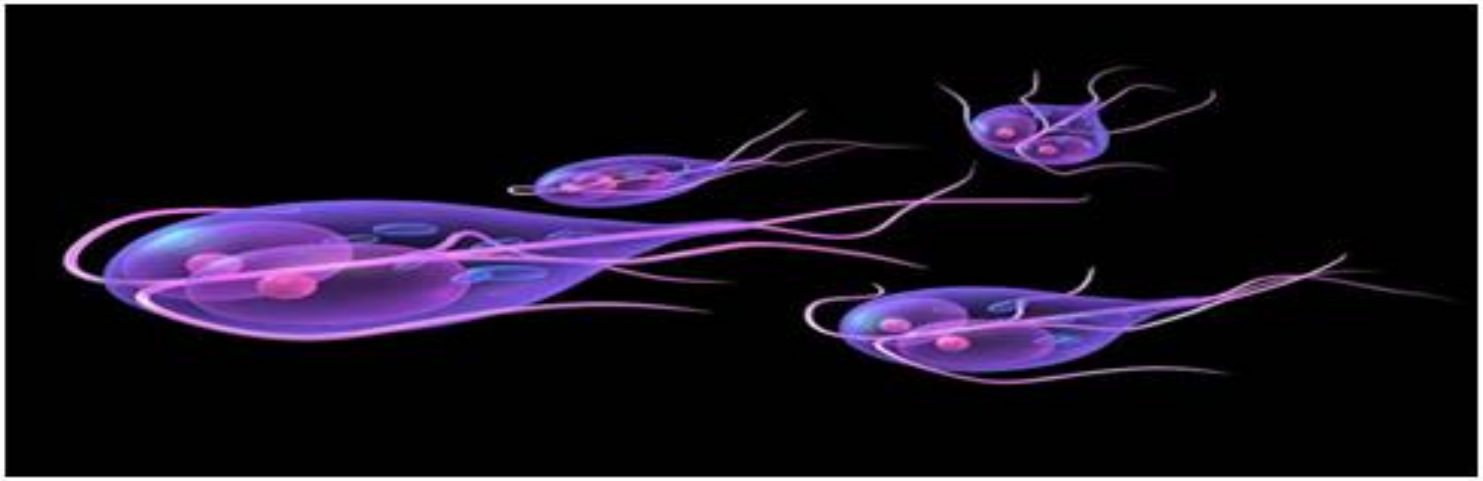

Thank you

Intestinal flagellate

Class:Mastigophora

Genus : Giardia

sp. : Giardia lamblia



This species is weakly pathogenic cause giardiasis (flagellate diarrhea)

In children more than adult

.

The life cycle is consist of :

1 - Trophozoites

2- Cysts

3- The infective stage is cysts

★**The infestation occur by ingestion of cysts with fecally contaminated drinks & food.**

The treatment :

1. quinacrine hydrochloride (atabrin) will cure 90% of infestations.
2. The alternative drug for resistant cases is metronidazole orally

(Genito urinary tract flagellates)

Class:Mastigophora

Genus : Trichomonas

Trich. Vaginalis

Is pathogenic species for man, cause trichomoniasis in both sexes ♂ **&** ♀

- **In** ♀ vaginitis
- In ♂ remain asymptomatic, but in some urethritis &prostitis may occur.

The life cycle is consist of trophozoites only . There is no cysts in life cycle . The trophozoites survive for 1- 2 days out of the body.

The life cycle is consist of trophozoites only . There is no cysts in life cycle . The trophozoites survive for 1- 2 days out of the body.

The infestation occur by sexual route or through contaminated toilet articles.

The treatment :

1. In women ⟶ metronidazole (orally)

   topical metronidazole tablets (intravaginal)

2. In men ⟶ metronidazole (orally)

blood & tissue flagellates

LEISHMANIASIS

class:Mastigophora

Genus : Leishmania

Sp. : 1. Leish. tropica

Is the least virulent form cause cutaneous leishmaniasis (oriental **sore** or Baghdad boil)

2. Leish. braziliensis

Is intermediate virulent form , cause muco cutaneous leishmaniasis in mouth & nostrils .

3. *Leish. donovani*

Is most virulent form , cause visceral leishmaniasis or kala azar

The life cycle is consist of :

1. amastigotes which found in reticulo endothelial system & lymphoid cells of skin in mammals.

2. Promastigotes which found in mid gut of sand flies females .

* The infective stage is promastigote injected by sand flies.

The treatment :

1. Antimonial drug as sodium stibogluconate (pentostam) by injection is drug of choice for all forms of leishmaniasis .

2. The alternative drug in case of resistance for antimonial drug is :

   * pentamidine by injection for infection with *Leish. donovani*

   * ampjotericin B by injection for infection with *Leish. braziliensis*

3. For oriental sore, beside to drug of choice :

   Cleaning of lesion + treatment with antibiotics **if secondary infection**

   can occur


thinking of you

Echinococcus

genus : Echinococcus

species : Echin. granulosus

Is the smallest tape worm , measured 3-6 mm in length commonly named as dog tape worms , consist of :

1. scolex
2. neck
3. three proglottids only

*_The habitat_ : the adult worms found in small intestine of dogs & other carnivorous (final hosts).

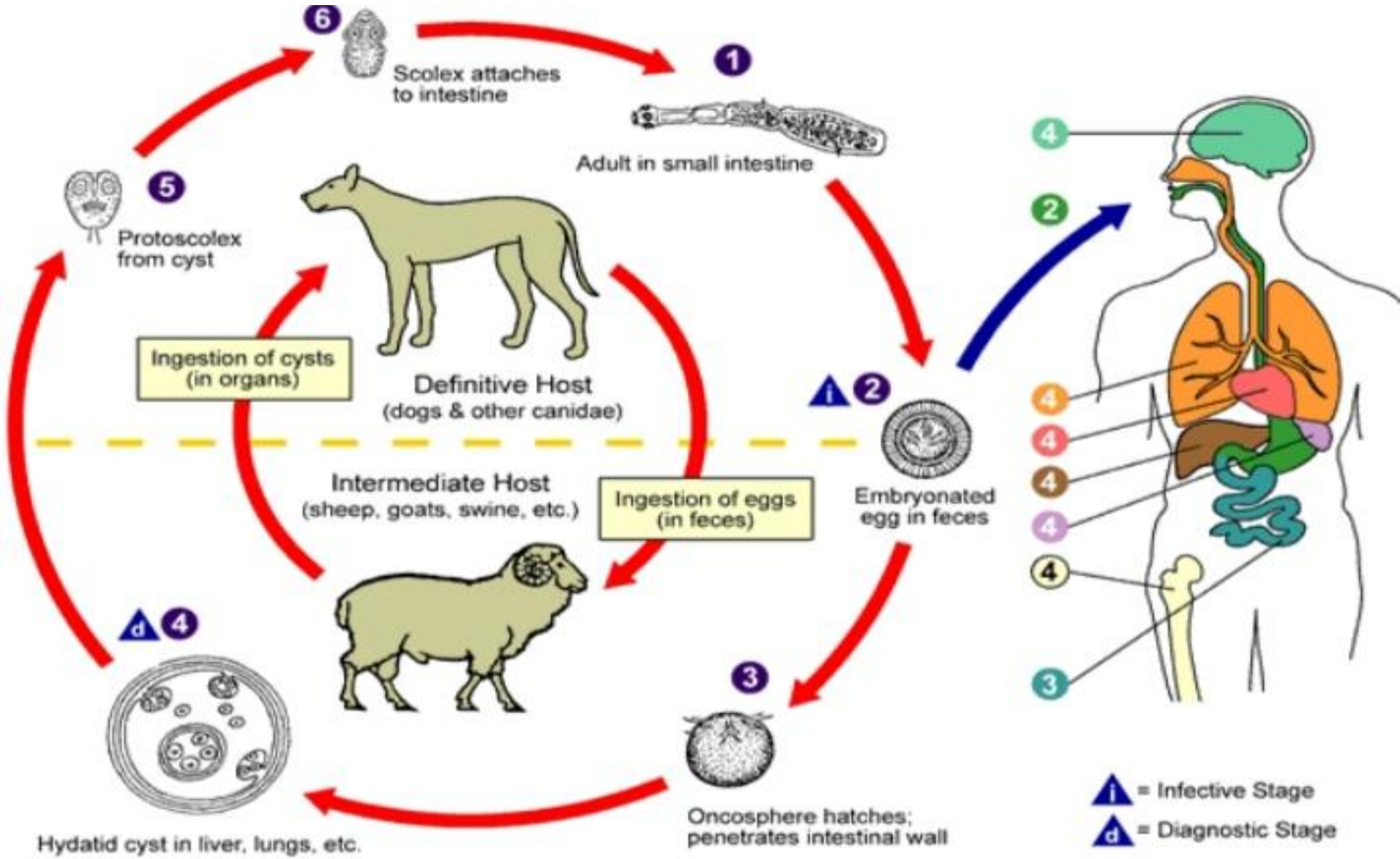
* The larval form is called hydatid cysts found in intermediate hosts :

human & other mammals specially herbivorous & cause hydatidosis

* The infective stage is eggs with hexacanths embryo that ingested with food contaminated with feces of dogs & carnivorous sp. In intermediate hosts the embryo in eggs will develop to the larval stage in different organs liver, peritoneal cavity ,brain & any other organs .

The infective stage for final hosts is protoscolices inside hydatid cysts.

The life cycle of *Ech. granulosus* :



The treatment : for hydatidosis

The surgery is remain the only successive routine method for treatment by remove the hydatid cysts from infected organs. + using of anti parasitic drugs as mebendazol or albendazol.

Hymenolepis

genus : *Hymenolepis*

sp. : *H . nana*

The common name : **Is the dwarf tape worm , measured 40 mm in length & consist of :**

1. scolex
2. neck
3. 200 proglottids

The habitat :

the adult worms live in small intestine of human mainly.

The infestation: occur by ingestion of fecally contaminated foods & drinks . Also the auto infestation may be occur directly in the same person.

The treatment :

1. Niclosamide (yomesan) orally as in case of taeniasis .

2. Alternative drug is paromomycin or praziquantel .


I LOVE YOU