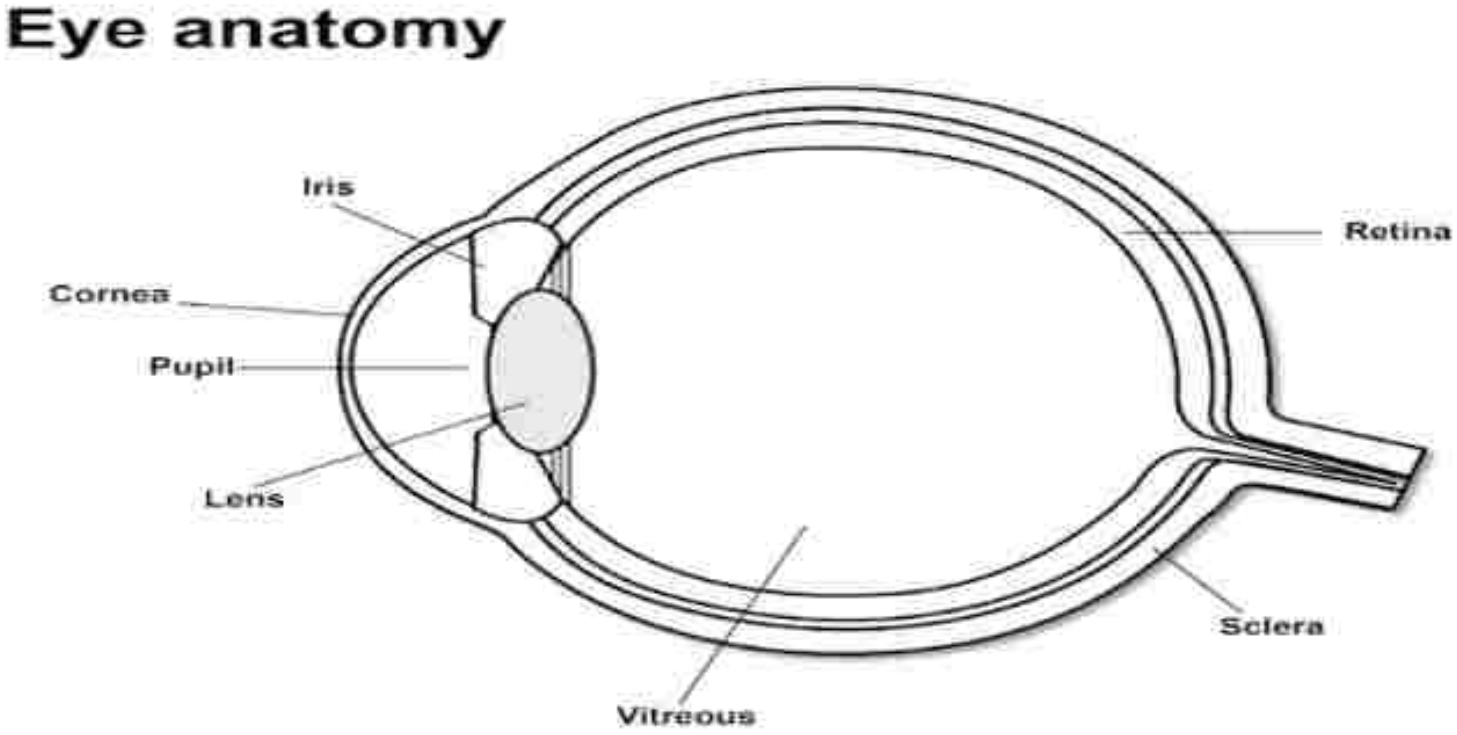
Medical Microbiology
Eye Infections

د. اسراء محمد رياض الحمداني
المرحلة الأولى \ قسم فحص البصر
المعهد التقني النجف الاشرف
٢٠٢٢\٢٠٢٣
Lec.٤

Eye Infections

- Eye infections may be classified according to the infectious organism or the structure within the eye that is affected. A wide variety of bacteria, viruses, fungi, and parasites can be responsible. The different structures that can become infected are determined by the anatomy of the eye.



Infectious organisms. A selection of the more common and/or harmful organisms responsible for eye infections is included in the following list.

- Bacteria
- • Staphylococcus spp. especially S. aureus
- • Streptococcus spp. especially S. pneumoniae
- • Haemophilus spp especially H. influenzae
- • Pseudomonas aeruginosa, which causes very rapid ulceration
- • Neisseria gonorrhoeae , which is a cause of infection both in neonates and in sexually active adults
- • Chlamydia trachomatis, which is a cause of infection both in neonates and in sexually active adults , responsible for trachoma

- Viruses
- • Adenovirus
- • Enteroviruses
- • Herpes simplex virus
- • Rubella virus

Fungi

- • Fusarium spp.
- • Aspergillus spp.
- • Candida spp.

Parasites

- • Acanthamoeba
- • Toxoplasma gondii
- • Toxocara

SYMPTOMS

- Red eyes
- Pain
- Eye discharge
- Watery eyes
- Dry eyes

CAUSES AND KINDS OF EYE INFECTIONS

- Pink eye (Conjunctivitis): is a very common condition .It most frequently arises as a result of a viral or bacterial infection of the mucous membrane of the eye (conjunctiva). However, noninfectious cases of conjunctivitis are also common, arising as a result of a seasonal or perennial allergic response. The condition may be acute or chronic, although cases due to either viral or bacterial infection are frequently self-limiting.

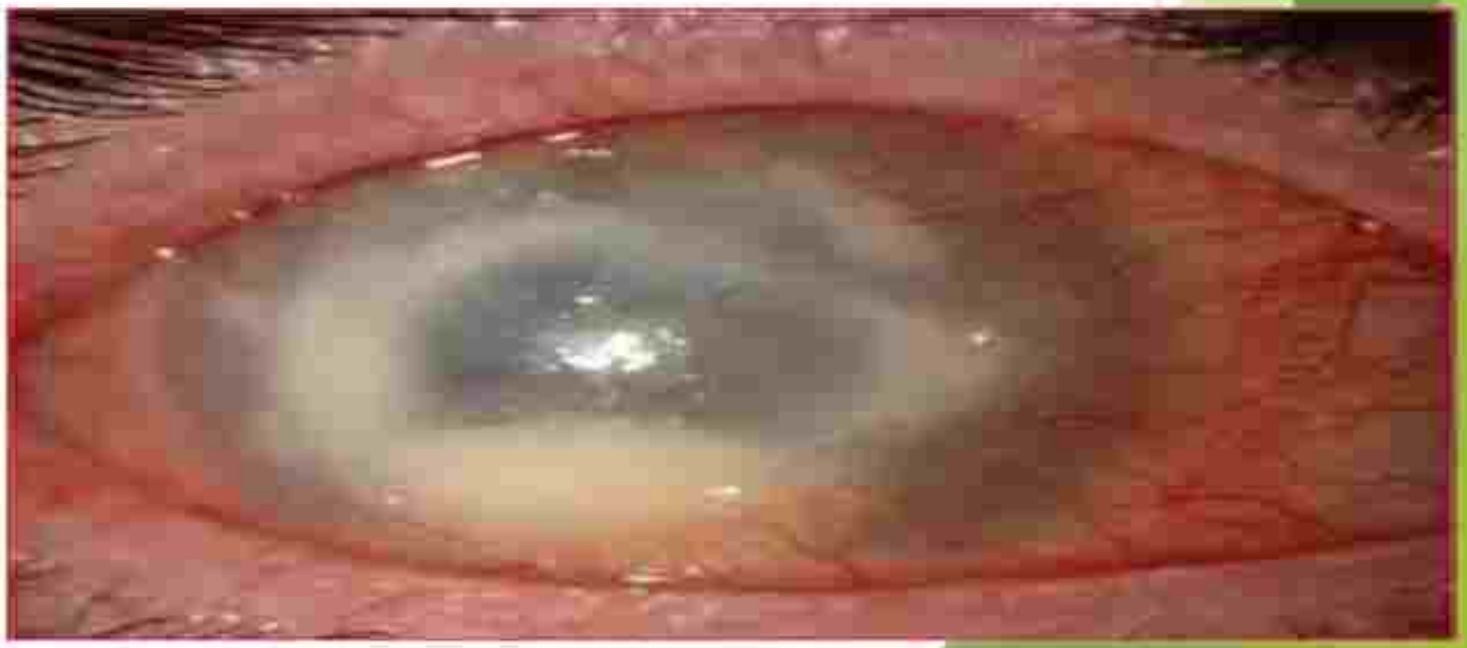
- • **Other microorganism eye infections (viral keratitis):** Besides common pink eye, different microorganism eye infections embrace ocular herpes that happens with exposure to the Herpes simplex virus.

- **Fungal redness .A** fungal infection can occur in different areas of the eye. Those located in the front layer of the eye are known as keratitis. This clear area is the cornea. If it affects the deeper layers of the cornea, a scar can form that may affect vision.
- A fungal infection that occurs inside of the eye is known as endophthalmitis . An endophthalmitis infection can impact the gel behind the lens of the eye (known as the vitreous) or the clear fluid between the lens and the cornea, known as the aqueous humor.
- The two types of endophthalmitis are:
- Exogenous: Fungal spores come from an external source and get into the eye.
- Endogenous: The fungal infection comes from elsewhere in the body via the bloodstream.

- Acanthamoeba redness(Acanthamoeba keratitis): a rare disease (Orphan disease), living infectious organism, affecting the cornea that can develop into a severe form and be seriously debilitating.
The infection is caused by the protozoa Acanthamoeba, frequently in contact lens wearers due to poor hygiene and improper use, in other cases it can be caused by ocular trauma in a rural environment.

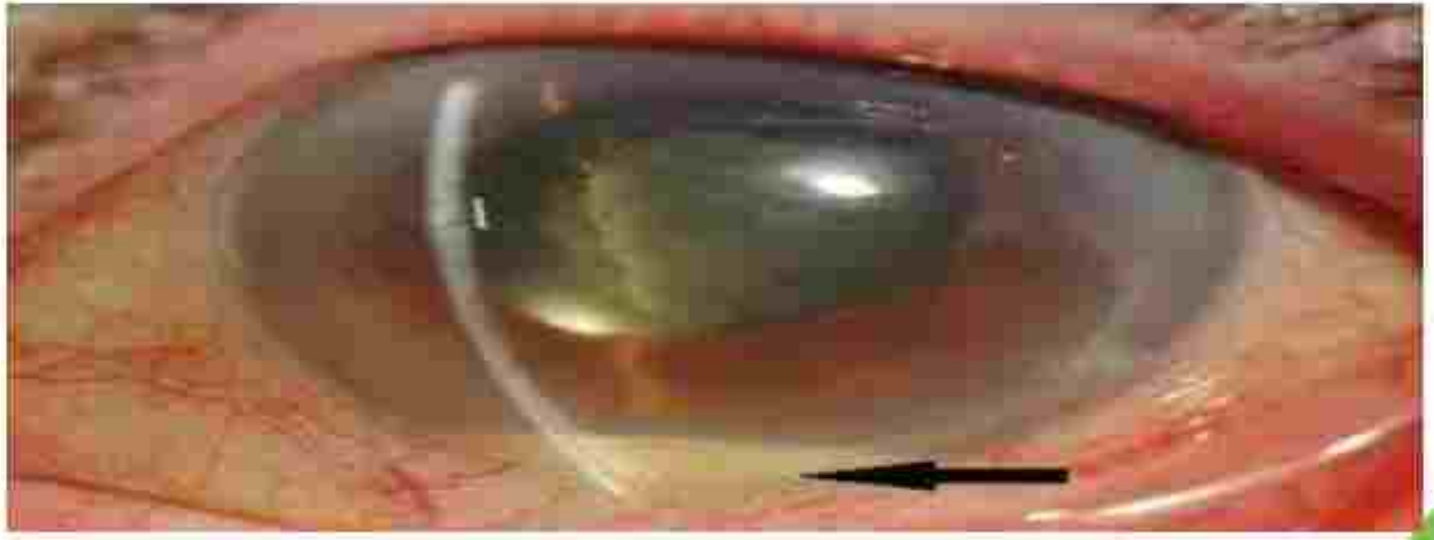
Symptoms :

Pain, redness and eye irritation; blurred vision; hypersensitivity to light, and excessive tearing.



- Trachoma is a chronic bacterial keratoconjunctivitis and is the leading infectious cause of blindness in the developing world. Repeated infections of the eyes with the relevant strains of Chlamydia trachomatis result in a sequence of tarsal conjunctivitis, scarring, shortening of the upper lid (so that the eyelashes abrade the cornea), trichiasis , and finally, corneal opacity.
- **Symptoms :**
- Mild itching and irritation of the eyes and eyelids.
- Eye discharge containing mucus or pus.
- Eyelid swelling.
- Light sensitivity (photophobia)
- Eye pain , Eye redness ,Vision loss.

- Endophthalmitis : term used to describe severe inflammation of the tissues inside the eye. The inflammation is typically due to infection by bacteria (e g. Staphylococcus species, Streptococcus species, Gram-negative bacteria) or fungi (e g. Candida, Aspergillus). It is rarely caused by viruses (herpes simplex or herpes zoster) or protozoa (e g. Toxocara , Toxoplasma). Sterile (non-infectious) endophthalmitis can develop as a reaction to lens fragments retained in the eye after cataract surgery or to drugs injected into the eye.



EYE INFECTION COMPLICATIONS

- An infection can also have an effect on interior parts of the higher and lower eyelids to form an infection or wen. Rubbing or “popping” an infection ought to be avoided, as this could cause a deeper, additional serious infection referred to as orbital redness. Orbital redness is associate degree infection of the tissues round the eyeball. It's a medical emergency as a result of, if not promptly treated, it will cause cecity, infectious disease and even death. Infection can also result in inflammation and blockage of the eye's tear system and cause redness.

EYE INFECTION TREATMENTS

- Fortunately, most typical microorganism eye infections will be effectively treated with prescription antibiotic eye drops or ointments and compresses.
- Many common microorganism eye infections resolve on their own. In cases of severe microorganism eye infections, associate degree antiviral eye drop could also be prescribed. Some microorganism eye infections need careful administration of steroid eye drops to cut back connected inflammation. Depending on the underlying reason behind your hordeolum , your doctor could impose antibiotics or antiviral medications that are taken orally. If your symptoms worsen or amendment, contact your specialist forthwith .

HOW TO FORESTALL EYE INFECTIONS

- follow these ١٠ tips to keep from contracting eye infections in the first place.
- ١. Wash your hands
- ٢. Don’t touch your eyes
- ٣. Clean your contact lenses
- ٤. Don’t share makeup brushes
- ٥. Pay attention to pink eye
- ٦. Watch out for injuries
- ٧. Eliminate pests
- ٨. Maintain mold-free environments
- ٩. Take a break from your contacts
- ١٠. Go to the doctor when you need to

- Thank you …….

Medical Microbiology

Sterilization and Disinfection

د .اسراء محمد رياض الحمداني
المرحلة الأولى \ قسم فحص البصر
المعهد التقني النجف الاشرف
٢٠٢٢\٢٠٢٣

Definition

- **Sterilization:** is the killing or removal of all microorganisms , including bacterial spores which are highly resistant.

- **Disinfection**: is the killing of many, but not all microorganisms (or reduction of number of contaminating organisms to a level that cannot cause infection, some organisms and bacterial spores may survive).

- **Disinfectants**: are chemicals that are used for disinfection. Disinfectants should be used only on inanimate objects.

Definition

- Antiseptics: are mild forms of disinfectants that are used externally on living tissues to kill microorganisms, e.g. on the surface of skin and mucous membranes.

- Bacteriostatic: is a condition where the multiplication of the bacteria is inhibited without killing them.

- ■ Bactericidal: is that chemical that can kill or inactivate bacteria. Such chemicals may be called variously depending on the spectrum of activity, such as bactericidal , veridical , fungicidal, microbicidal , sporicidal, tuberculocidal or germicidal.


Dettol


zep
Antibacterial
Disinfectant


fresh
antiseptic
disinfectant


Antiseptic
Spray


Lysol
Lysol
Lysol

USES OF STERILIZATION

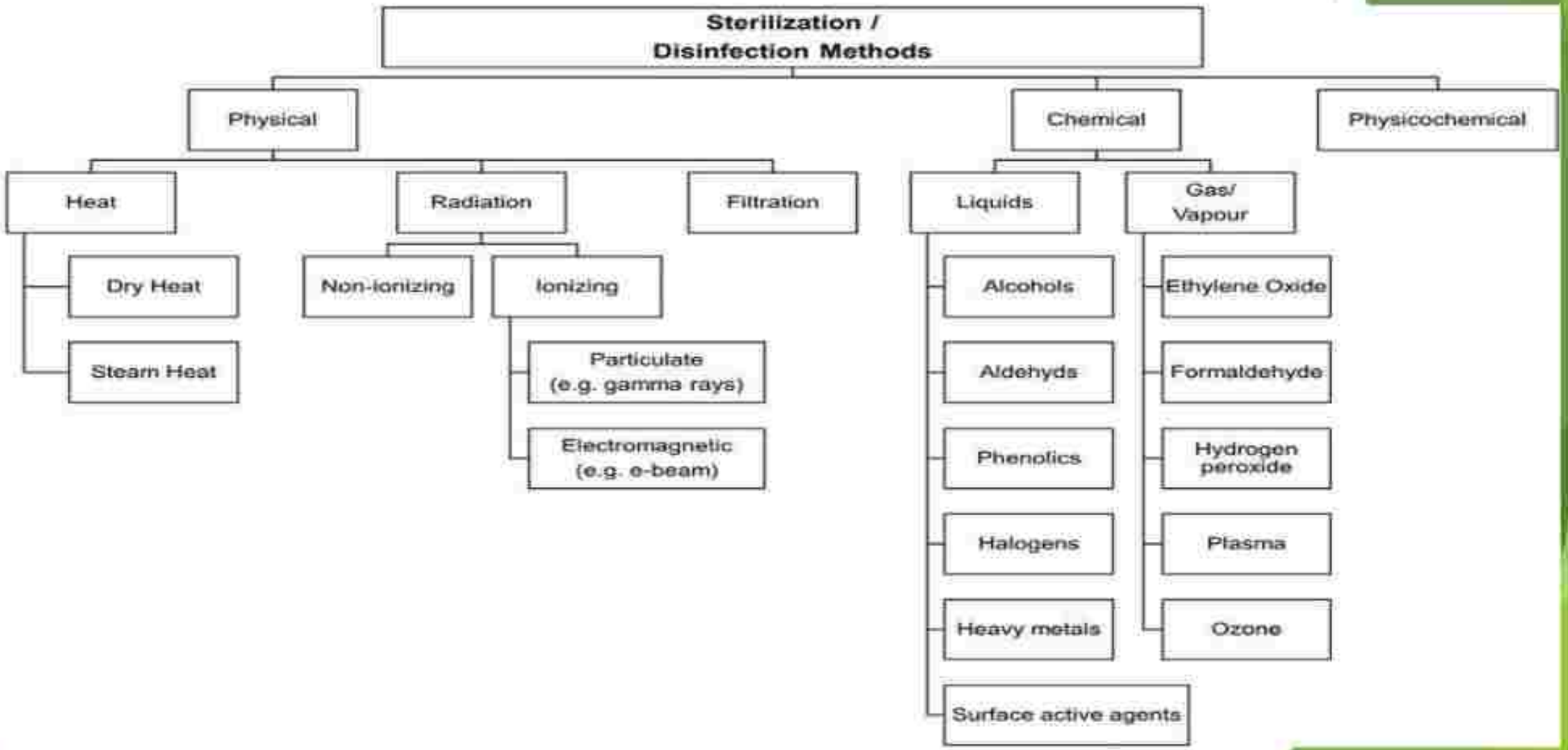
١. Sterilization for Surgical Procedures: Gloves, aprons, surgical instruments, syringes etc. are to be sterilized.

٢. Sterilization in Microbiological works like preparation of culture media, reagents and equipment where a sterile condition is to be maintained.

STERILIZATION METHODS

- ١. **Physical Method.**
  - (a) Thermal (Heat) methods
    - I- Dry heat (red heat, flaming & hot air oven)
    - II- Moist heat (below ١٠٠ °C, at ١٠٠ °C & above ١٠٠ °C)
  - (b) Radiation methods
    - I- Non-ionizing radiation (Ultraviolet & Infrared radiation)
    - II-Ionizing radiation (X-ray & gamma ray)
  - (c) Filtration methods
- ٢. **Chemical Method (liquid & gaseous)**

STRELIZATION METHODS



HEAT STERILIZATION : DRY HEAT

- ١. **Red heat:** bacteriological loops and tips of forceps are sterilized by holding them in Bunsen flame till they become red hot.

- ٢. **Flaming:** scalpels, mouth of test tubes, flasks, glass slides and cover slips are passed over a Bunsen flame, but not heating it to redness. Even though most vegetative cells are killed.

- ٣. **Hot air oven:** This method was introduced by Louis Pasteur. Articles to be sterilized are exposed to high temperature (١٦٠ °C) for duration of one hour in an electrically heated oven.

HEAT STERILIZATION : DRY HEAT

RED HEAT

HOT AIR OVEN

FLAMING

HEAT STERILIZATION: MOIST HEAT

- Moist heat acts by coagulation and denaturation of proteins.
- **١. At temperature below ١٠٠ °C**

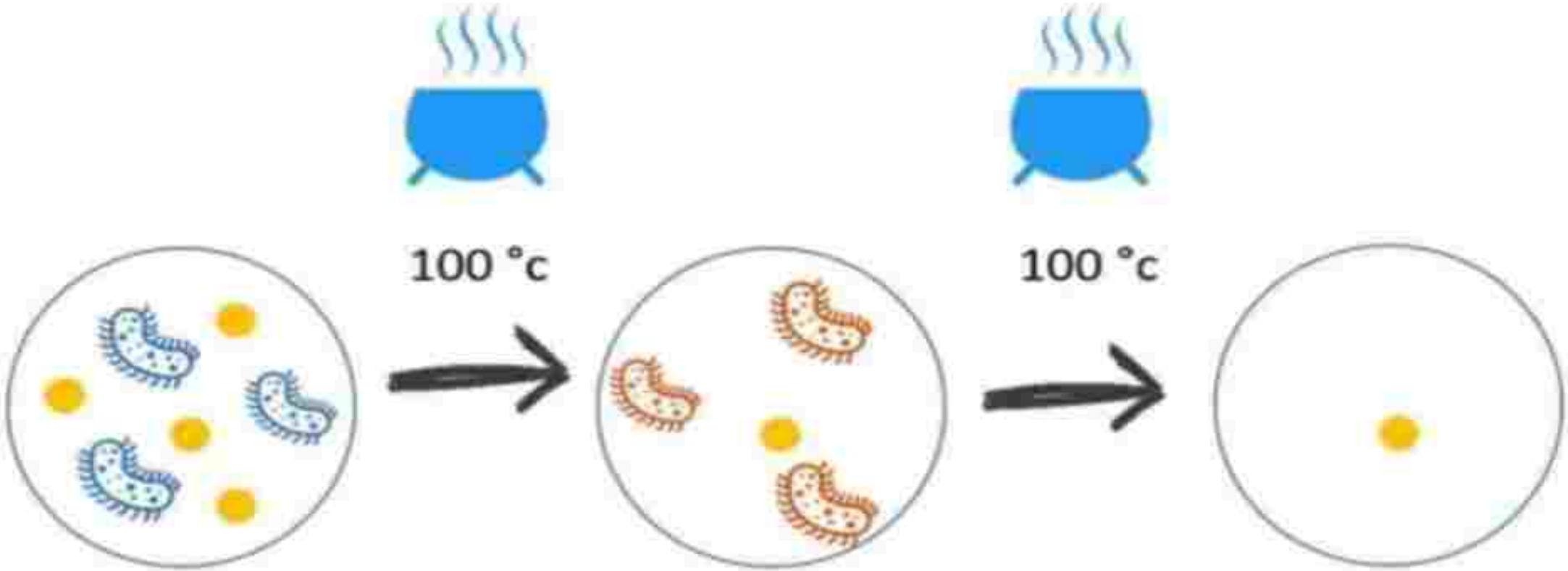
- **>Pasteurization:** employed by Louis Pasteur. Currently this procedure is employed in food and dairy industry. There are two methods of pasteurization, the holder method (heated at ٦٣ °C for ٣٠ minutes) and flash method (heated at ٧٢ °C for ١٥ seconds) followed by quickly cooling to ١٣ °C. This method is suitable to destroy most milk borne pathogens like *Salmonella*, *Mycobacteria*, *Streptococci*, *Staphylococci and Brucella*, however *Coxiella* may survive pasteurization.

- >**Clothes sterilization** at ٧٢ °C -٨٠ °C by washing them for ٥-١٠ minutes.

HEAT STERILIZATION: MOIST HEAT

- ٢. At temperature of ١٠٠ °C:
- Boiling: Boiling water (١٠٠ °C) kills most vegetative bacteria and viruses immediately.

- Steam at ١٠٠ °C: Media such as TCBS, DCA and selenite broth are sterilized by steaming. Sugar and gelatin in medium may get decomposed on autoclaving, hence they are exposed to free steaming for ٢٠ minutes for three successive days. This process is known as tyndallisation (after John Tyndall) or fractional sterilization or intermittent sterilization. The vegetative bacteria are killed in the first exposure and the spores that germinate by next day are killed in subsequent days. The success of process depends on the germination of spores.



TYNDALLIZATION

HEAT STERILIZATION: MOIST HEAT

- **٣. At temperature above ١٠٠ °C:** (Autoclaving).
- In an autoclave the water is boiled in a closed chamber.
- As the pressure rises, the boiling point of water also raises.
- At a pressure of ١٥ lbs inside the autoclave, the temperature is said to be ١٢١ °C.
- Exposure of articles to this temperature for ١٥ minutes sterilizes them.
- To destroy the infective agents associated with spongiform encephalopathies (prions), higher temperatures or longer times are used; ١٣٥ °C or ١٢١ °C for at least one hour are recommended.

RADIATION

Two types of radiation are used, ionizing and non-ionizing.

- Non-ionizing rays are low energy rays with poor penetrative power while ionizing rays are high-energy rays with good penetrative power. **Since radiation does not generate heat, it is termed "cold sterilization".**
- **Non-ionizing radiation:**

  >Ultraviolet & infrared radiation

  > Used in sterilizing large number of disposables in short time.
- **Ionizing radiation:**

  >Such as X-ray & gamma ray

Filtration

- Filtration does not kill microbes, it separates them out.
- Membrane filters with pore sizes between ٠,٢-٠,٤٥ µm are commonly used to remove particles from solutions that can't be autoclaved.
- **It is used to remove microbes from heat labile liquids such as serum, antibiotic solutions, sugar solutions, urea solution**.
- Various applications of filtration include removing bacteria from ingredients of culture media, preparing suspensions of viruses and phages free of bacteria, measuring sizes of viruses, separating toxins from culture filtrates, counting bacteria, clarifying fluids and purifying hydatid fluid.

CHEMICALS METHODS OF STERILIZATION

- **Disinfectants**: are those chemicals that destroy pathogenic bacteria from inanimate surfaces.
- Some chemicals have very narrow spectrum of activity and some have very wide.
- Those chemicals that can sterilize are called **chemisterilants.**
- Those chemicals that can be safely applied over skin and mucus membranes are called **antiseptics.**
- An ideal antiseptic or disinfectant should have following properties:

PROPERTIES OF IDEAL ANTISEPTICS

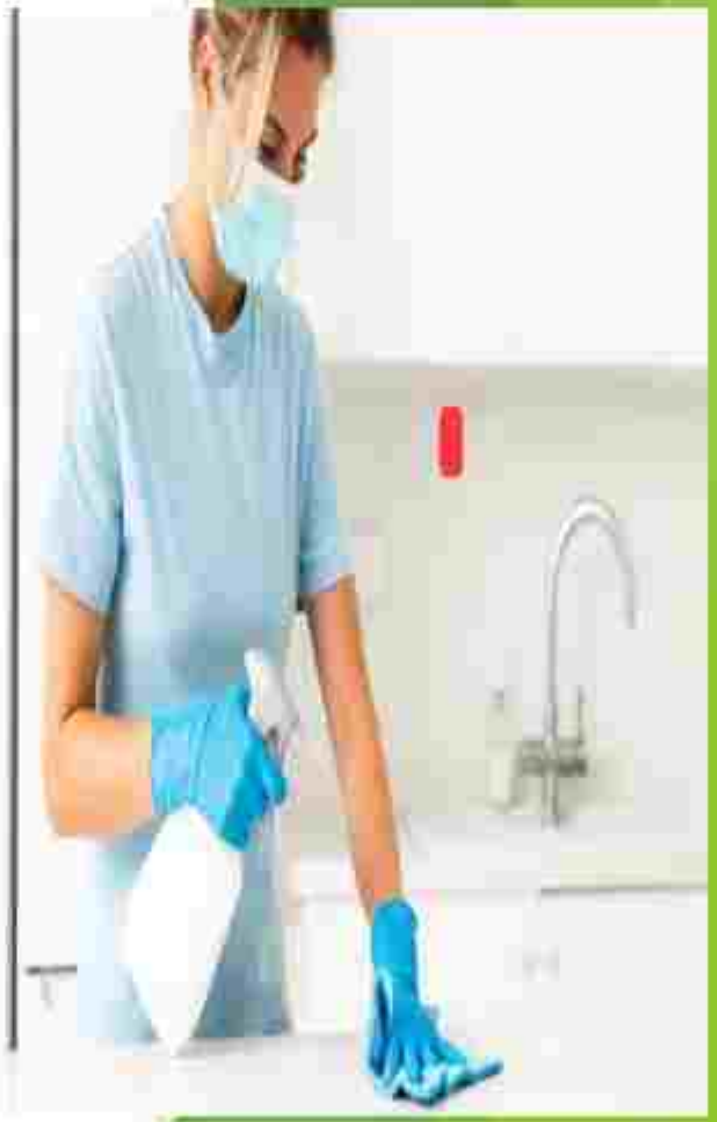
- Should have wide spectrum of activity.
- Should be able to destroy microbes within practical period of time.
- Should be non-toxic, non- allergenic , non-irritative or non-corrosive.
- Should be active in the presence of organic matter .
- Should not have bad odour.
- Should not leave non-volatile residue or stain.
- Should make effective contact and be wettable.
- Should be active in any pH.
- Should be speedy.
- Should have high penetrating power.
- Should be stable.
- Should have long shelf life.
- Efficacy should not be lost on reasonable dilution.
- Should not be expensive and must be available easily.

Aseptic technique

- Aseptic technique is a set of specific practices and procedures performed under carefully controlled conditions with the goal of minimizing contamination by pathogens.

- Aseptic technique in medical microbiology lab may involves (wearing gloves, work at sterile area, flaming of top side of flasks and tubes before and after opening, etc.).

Aseptic technique



POST _ TEST

- What is the difference between:
  ١. sterilization and disinfection?
  ٢. bacteriostatic and bactericidal?
  ٣. tantalization and pasteurization?
- What is "aseptic technique" refer to?
- Enumerate the methods of moist heat sterilization with examples.
- What is the principle of moist heat sterilization?
- When you should be use filtration? Give examples.
- What are the physical conditions in:

١. Autoclave? ٢. Hot-air oven?

Medical Microbiology

Culturing of bacteria and media types

د. اسراء محمد رياض الحمداني
المرحلة الأولى \ قسم فحص البصر
المعهد التقني النجف الاشرف
٢٠٢٣\٢٠٢٢

Culturing of bacteria:

- A microbial culture is a method for multiplying microorganisms by letting them reproduce in predetermined culture media under controlled laboratory conditions. Microbial cultures are used to determine the type of organism and its abundance in the sample being tested, or both.

Purpose of culturing:

- Isolation of bacteria.
- Determining the properties of bacteria.
- Maintenance of stock cultures.
- Estimate viable count.
- To test for antibiotic sensitivity.
- To create antigens for laboratory use.

Agar:

- Is a complex carbohydrate extracted from sea algae called **Gelidium** used in preparing culture media as solidifying agent because of its characteristics which are :

١. Its melting properties , melt at ٩٠-١٠٠ ° C and solidify at ٤٢ ° C.

٢. It has no nutritive value for majority of bacteria.

Classification of culture media:

Bacterial culture media can be classified into:

١. Consistency (physical state).
٢. Nutritional components (ingredients).
٣. Functional use.

Classification based on consistency:

- ١. Liquid media: ٠% agar
- ٢. Solid media: ٢% agar
- ٣. Semi-solid media: ١- ٠,٥% agar

Classification based on nutritional components:

- ١. Simple media: It is also called basal media. Contain natural material rich with vitamins and their structure and concentration are not defined such as milk and blood.

- ٢.Defined media (synthetic media) : medium contain chemical material , their structure and concentration exactly defined .

- ٣. Semi _synthetic media : Contain natural material as well as chemical material .

- ٤. Living media : medium contain living tissue used to culturing viruses and cancer cell.

Classification based on functional use or application:

١. Enriched media:

The media are enriched by adding blood serum or egg . These media are used to isolate pathogens from a mixed culture, since they stimulate the desired bacterium and inhibit the growth of unwanted bacteria.

Examples of enriched media: Blood agar and chocolate agar.

٢. Selective media:

Selective media are designed to inhibit unwanted bacteria and help to recover pathogen from a mixture of bacteria. can be made by the addition of antibiotics, dyes, chemicals, alteration of pH, or a combination of these.

Examples of selective media: Eosin methylene blue (EMB) agar.

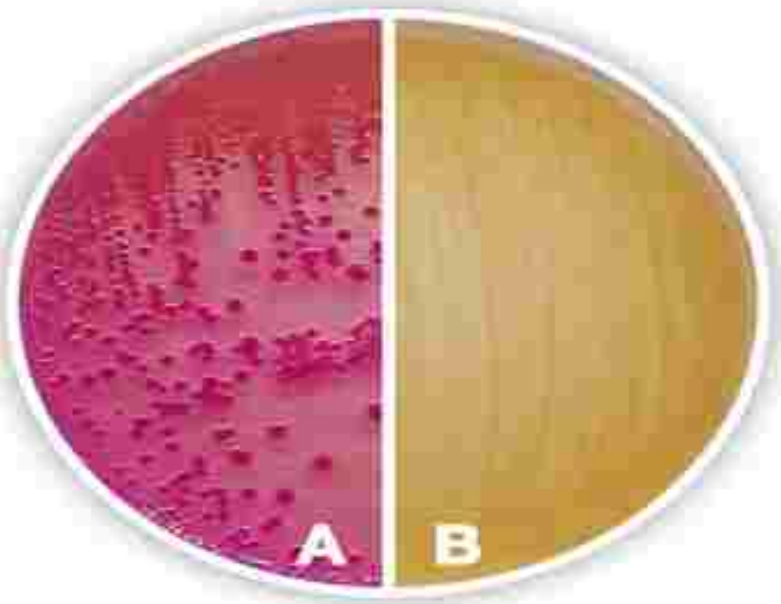
٣. Differential media(indicator):

An indicator is included in the medium .a particular organism causes change in the indicator .

Examples of differential media: MacConkey agar.

Blood agar

MacConkey agar



Eosin Methylene Blue (EMB) Agar

Classification based on functional use or application:

- ٤. **Transport media:**

  These media are used when cannot be cultured soon after collection , to prevent overgrowth of contaminating bacteria it should contain only buffers and slats. Lack of carbon, nitrogen, and organic growth factors so as to prevent microbial multiplication.

  Examples of transport media: Cary-Blair medium , Amies medium

- ٥. **Preservation media:**

  Media used for storing the bacteria for long period of time .

  Examples of Preservation media: Egg yolk medium .

Transport media

COPAN SWABS

Plastic tubes filled with 5ml of Amies Agar Medium. Sterilized by ionizing irradiation. Shelf life 15 months from date of manufacture.

STARPLEX SWABS

Plastic tubes filled with 5ml of Amies Agar Medium. Sterilized by ionizing irradiation. Shelf life 24 months from date of manufacture.

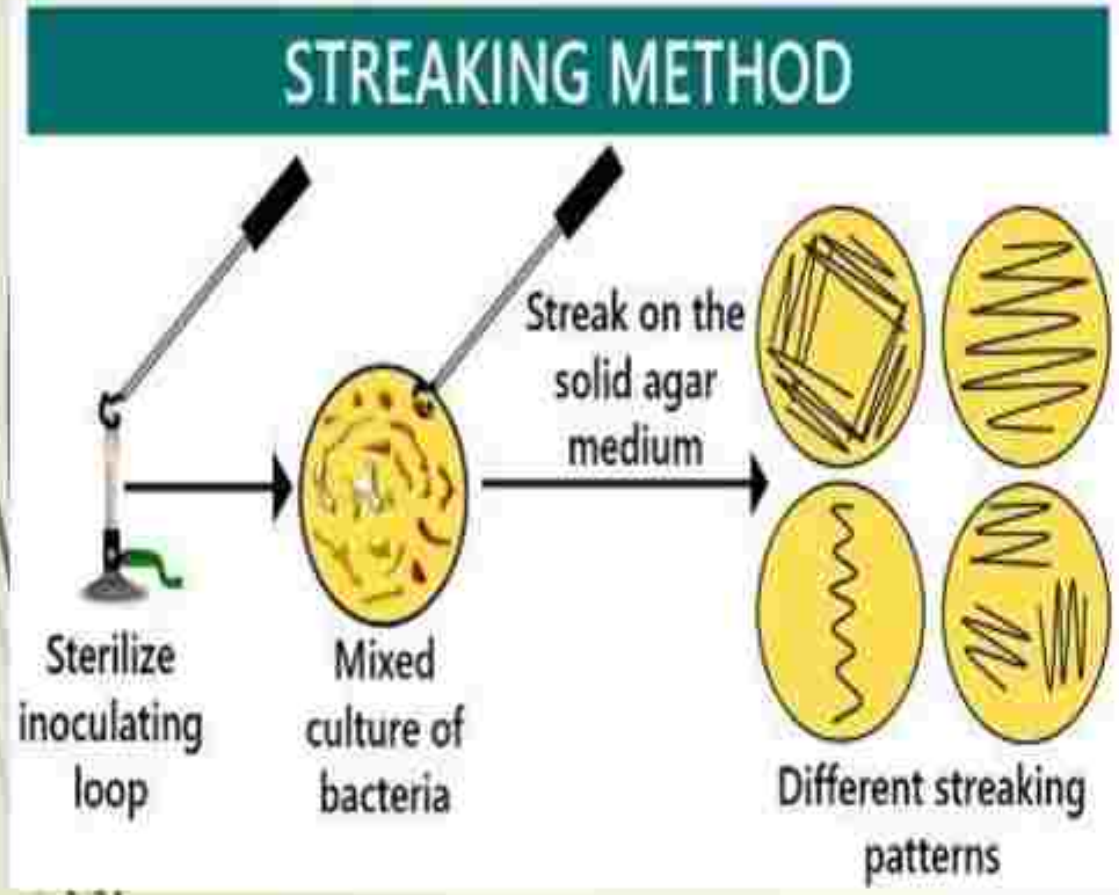
Preservation media Egg yolk medium

Upper side

Reverse side

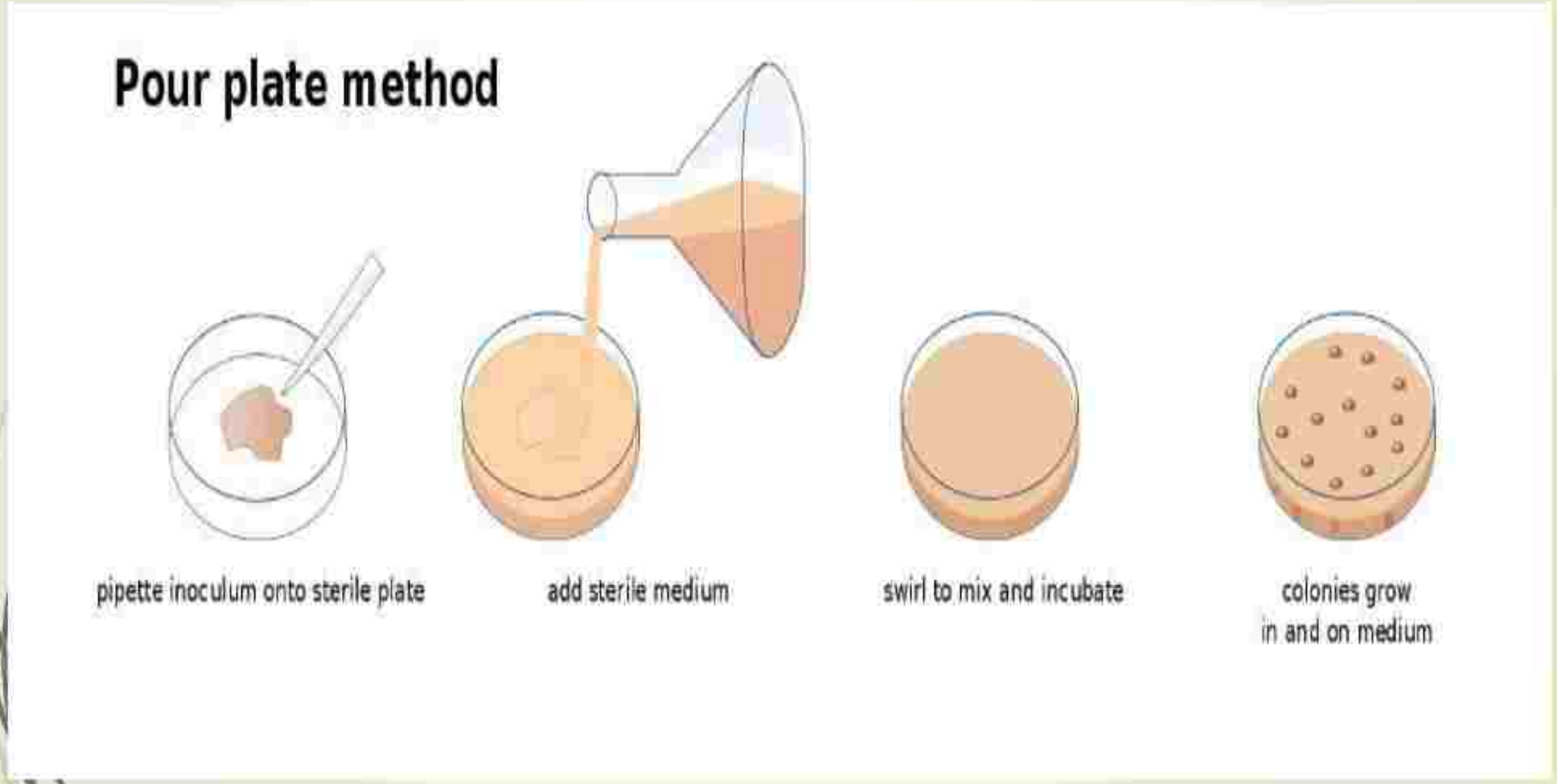
Culturing methods:

١. Streak _ plate method : طريقة تخطيط الطبق



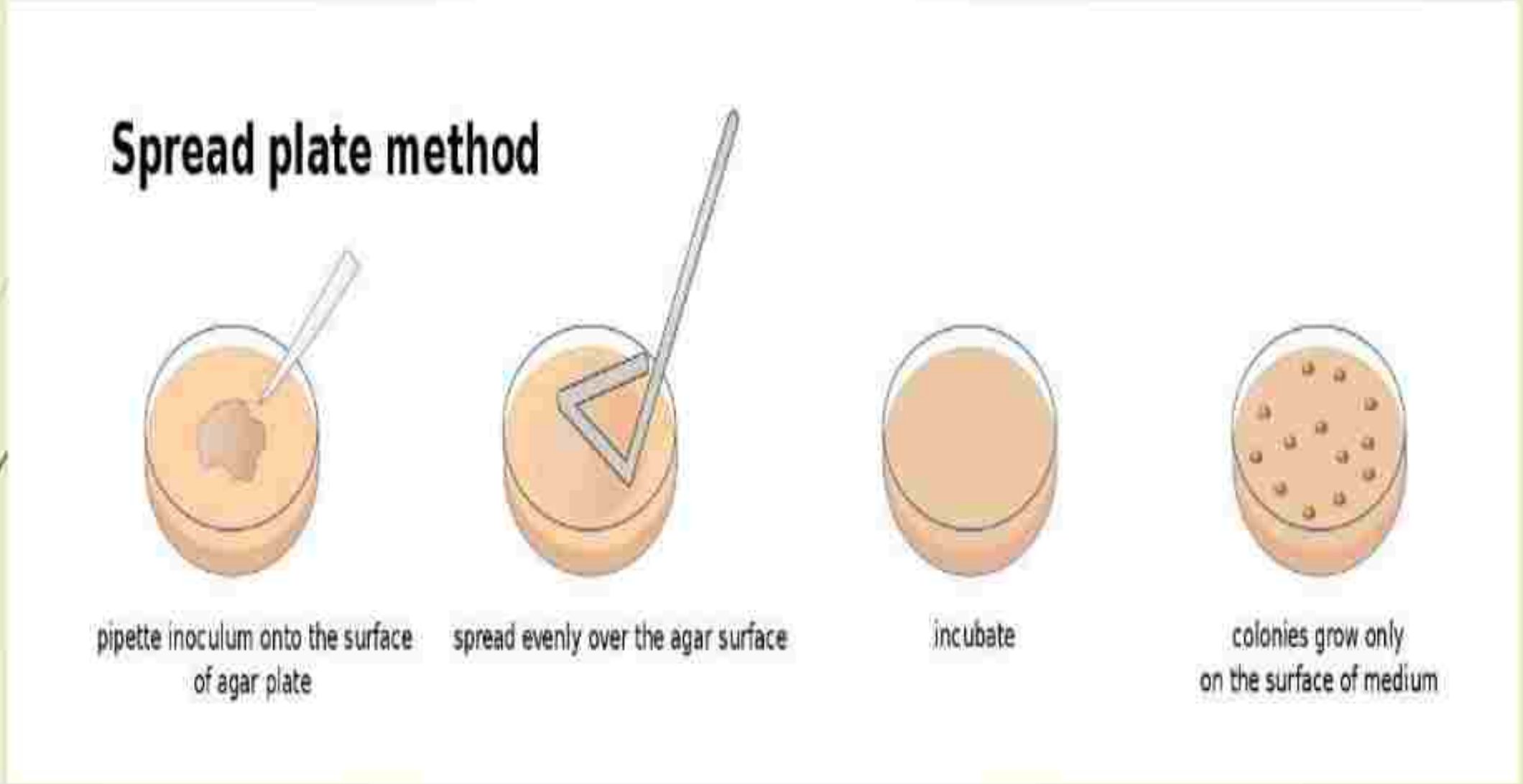
Culturing methods:

٢. Pour plate method: طريقة الصب في الطبق



Culturing methods:

٣. Spreading _plate method: طريقة النشر في الطبق



Culturing methods:

٤.Agar _slope method (Slant): طريقة الاكار المائل

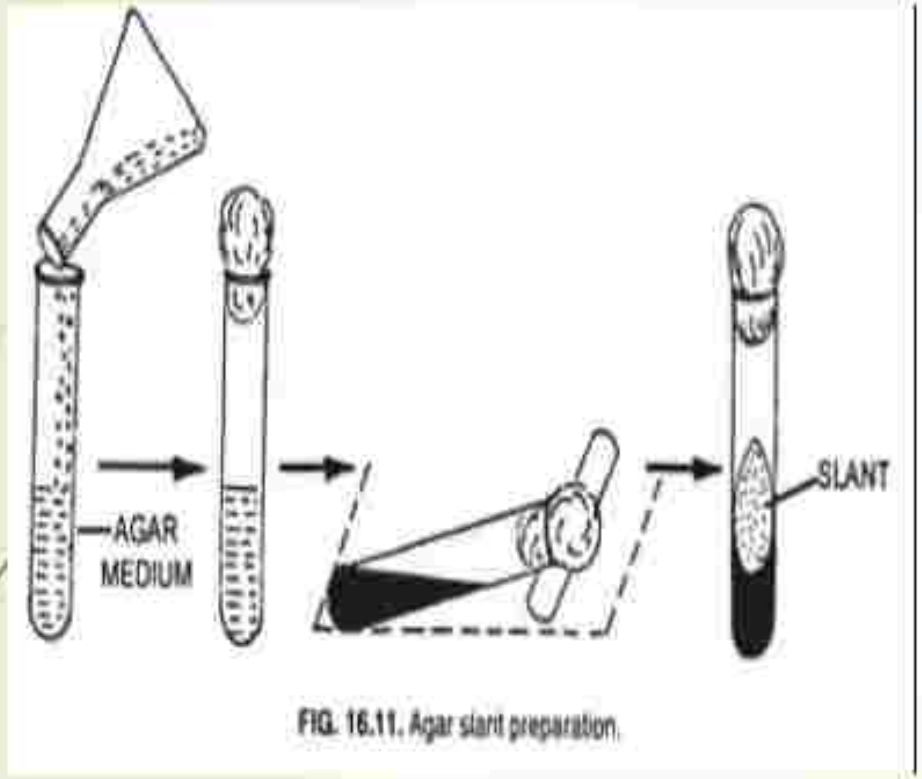


FIG. 16.11. Agar slant preparation.

THANK YOU……..

Medical Biology

د .إسراء محمد رياض الحمداني

المرحلة الأولى

المعهد التقني / النجف الأشرف

2023/2022

MICROBIOLOGY

Pre-test

Circle the correct answer

A- The role of using alab is to assist in the_____

1-diagnosis. 2-Treatment

B- Medical lab technician analyze to :

1-Control of disease blood
2- cells and body fluid
3- Body fluids only
4- blood cells &body fluid

C-The technician plays a key role in_ _ _ _ _

1- diagnosis 2- treatment 3- diagnosis and treatment
4- none

C- Modern medicine would be_____

1-impossible without lab test
2-possible without alab test
3-occasionally depends on lab test
4- none

D-There are many types of techniques used which may be_____

1-either manual or mechanical
2-manual &mechanical
3-manual, mechanical & others
4-none

Introductio:

The science of biology is the study of life in all its aspects.

Biology is divided into two sub-science

1- Zoology: deals with animals

2- Botany: deals with plants

Some important terms in biology:

A. *Morphology: is the study of external form.*

B. *Anatomy: is the study of internal structure.*

C. *Physiology: is the study of function.*

D. *Embryology: is the study of development.*

E. *Taxonomy: is the study of classification.*

F. Ecology: is the study of the relationship between organism and their habitats.

The general characteristics of living organisms:

1- *Protoplasm.*

2- *Metabolism.*

3- *Growth.*

4- *Irritability and movement.*

5- *Reproducti*

Protoplasm : All living organism are composed of this substance, which has been termed (living matter). Protoplasm is a complex system in which there is a constant interchange of materials between the different components.

Metabolism: A living organism can be distinguished from a non-living things by its ability to show spontaneous activity, to do work. In the process of metabolism the energy obtained by the living organism. The source of energy in a living organism is that contained in some of the chemical compounds, such as carbohydrates and proteins. The molecules of these compounds contain energy, which can be released by a series of exothermic reaction, called "respiration".

The ultimate source of energy is the sun. plants alone have power of obtaining energy from sun light, since plants can synthesize organic substances like carbohydrates from inorganic compounds, CO_2 and H_2O by the process of "photosynthesis".

Growth: as a result of nutrition more substances are produced by the organism under normal condition that are used up in respiration. In this way a definite increase in the amount of protoplasm occurs ,with the result that organism grows.

Irritability and Movement: All living organism exhibit irritability, that is, they respond to external stimuli. This response generally takes the form of movement. In animals, movement is highly developed, for it is necessary asa mean of obtaining food.

Reproduction: The power of reproduction is common in all living organisms. It consist in the formation of new individuals similar to these of previous generation.

Micro-organism: Are those organisms which are invisible to the naked eye.

Functions:

1- Play role in the nitrogen and carbon cycles.

2- Contribute to maintaining the atmosphere oxygen level.

Microorganisms include:

1- Fungi.

2- Protozoa

3- Bacteria

4- Viruses

General characteristics of bacteria:

1- bacteria are unicellular free living organisms without chlorophyll, having both DNA and RNA.

2-They are able of performing all essential process of life like growth, metabolism and reproduction.

3-They have rigid cell wall containing muramic acid.

4- Most bacteria are so small that their size is measure in terms of micron. Generally cocci 1m in diameter and bacilli are (2m-10m) inlength and (0.2m-0.5m) in width.

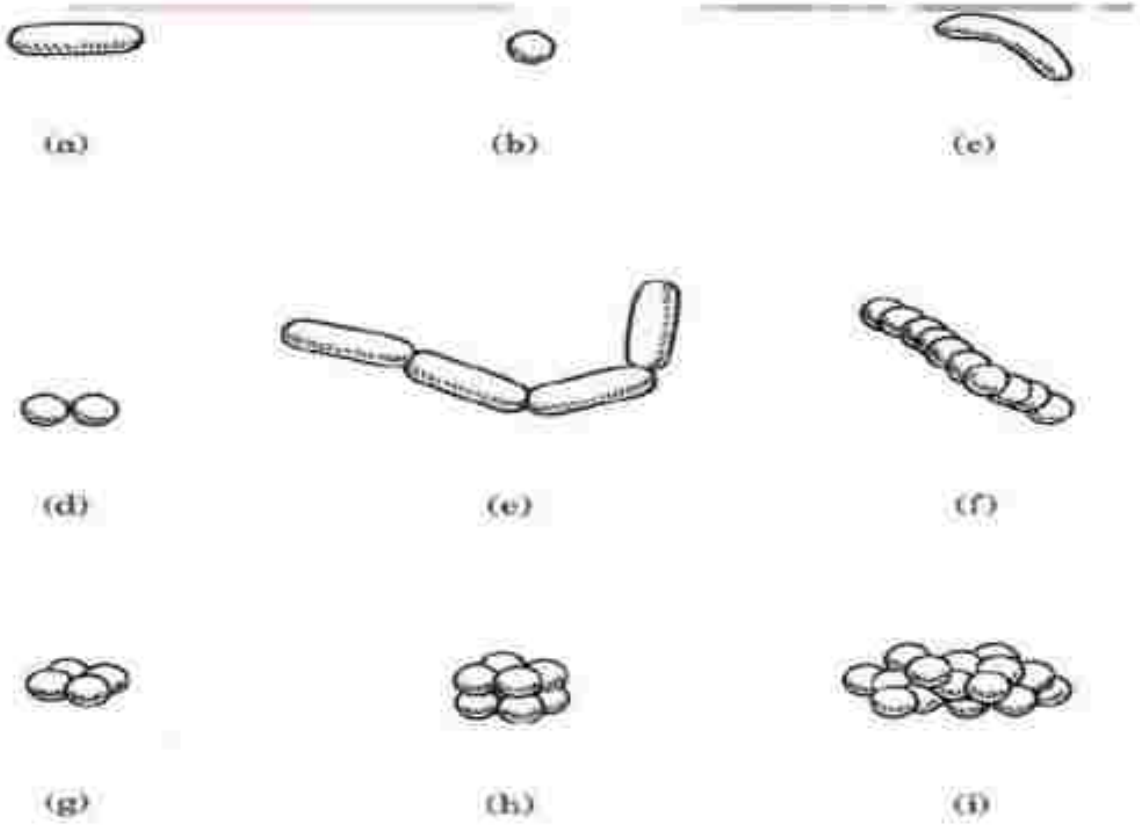
5-The major form of bacteria are spheres , rods , curved rod and spiral.

A –bacilli B- cocci C- curved D- cocci in pair

E-bacili in chain

F-cocci in chain

G-cocci in cluster



Bacterial structures

capsule: is the kind of hydrophilic gel surround many bacterial cells.Most capsule are polysaccharides and a few are proteins.

Functions

1- Capsule can protect bacteria

2- Role capsule in adherence and colonization like The ability of streptococcus salivarius cells to adhere to the surface of teeth.

Cell wall : Internal to the capsule, rigid wall surround all bacteria cells.

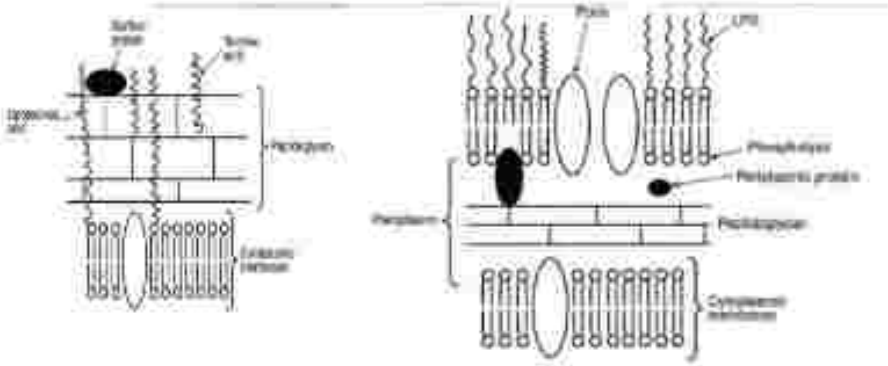
Functions

1-Cell wall protect the cell from mechanical disruption and from being burst by the turgor pressure

2-Provides a barrier against toxic chemical and biological agents.

3-Cell wall is responsible for the shape of the cell.

Bacteria could be divided into two groups depending on their reaction to a particular stain procedure put by Christian Gram. It is depended on the differential ability of ethanol or ethanol acetone mixtures to extract Iodine crystal violet complexes, from bacteria cells. These complexes are readily extracted from one group of bacteria termed (Gram negative) , they are retained by the other termed (Gram positive). Gram positive wall contain a large amount of peptidoglycan compared to Gram negative wall.



G+bacteria (cell wall) G-bacteria

Cell membrane : Cell membrane of bacteria is containing phospholipids& proteins. The bacterial cell membrane is rich in proteins (up to 70 % of its weight) & does not contain sterols.

Functions

1- The bacterial chromosome is attached to the cell membrane, which play a role in segregation of daughter chromosomes at cell division , like to the role of mitotic apparatus of eukaryotes

2- The membrane is the site of DNA synthesis , cell wall polymers and membrane lipid.

3- Contain the entire electron transport system in the cell (like to the mitochondria)

4- Contains recipto proteins that function in chemotaxis

5- Involved in secretion to the exterior of proteins (exoproteins), including exotoxins & enzymes involved in the pathogenesis of disease.

Flagella : are organelles of motility found in many species of bacteria (G+ &G-).

They may distributed:

1- *Around the cell*

2- *At one pole*

3- *At both ends of the cell.*

Flagella are helical organs of locomotion , consist entirely of protein, encoded in genes called Fla (for flagella)

Functions

1- *Motility*

2- *Chemotaxis*

Pili : are molecular found on the surface of cells of many G+ and Gspecies They are composed of molecules of proteins called pilin arranged to form a tube with a minute , hollow core.

There are **two general classes**:

1- Common pili : cover the membrane of the cell.

2- Sex pili : diagnostic of a male bacterium. There is only one per cell , and the sex pili is longer and thicken than a common pili.

Function

There are, adhesions, which are responsible for the ability of bacteria to colonization.

Cytosol: is bounded by the cell membrane. It appear granular because its contain ribosomes. Each ribosome is a ribonucleoprotien.

Functions

1- All of the metabolic reaction of the cell take place in the cytosol

2- Major location of a great fraction of the 2000-3000 different enzymes of the cell

3- Contain nutritional storage granules. The most consist glycogen or Polymetaphosphate.

Nucleoid

The bacterial have a single chromosome and typically consist of about 4000 genes encoded in one , large , circular molecule of double strand DNA. Each region contains chromosomes coated by polyamins andsome specialized DNA binding proteins, but not with the structure of eukaryotic chromosome .Because it is not surrounded by a membrane , itis not called a nucleus.

The absence of nuclear membrane in prokaryotic cell a great advantage for rapid growth in changing environment.

Function

Contain the genes that responsible of the structure and activity of the cell.

Plasmids and it's are small ,circular, conveniently closed , double strand DNA molecules separate from the chromosome and found in many bacterial cells. More than one type of plasmid or several copies of a single plasmid may be present in the cell.

Function

1- Carry genes coding for the production of enzymes that protect the cell from toxic substances like antibiotic resistance is often plasmid determination.

2- Many virulence factors ,such as production of some pili and some exotoxins, are also determinate by plasmid genes.

3- Some plasmids code for production of a sex pili.

Spores: Endospore are small ,dehydrated, metabolically quiescent form that are produced by some bacteria in response to nutrient limitation.

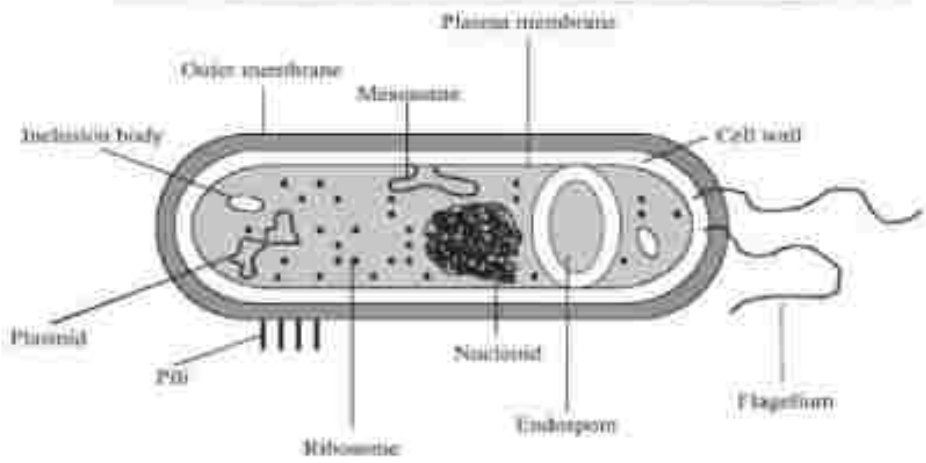
Very few bacteria produce spores ,such as

1- clostridium tetani, which grow in absence of O2

2- Bacillus subtilis, which grow in presence of O2

Some sporing bacteria are importance in medicine, causing disease such as (anthrax, tetanus, gas gangrene, and botulism). The bacterial spore is not reproductive structure. One cell forms one spore (the process is called sporulation). The spores may persist for a long time and then ,on the normal condition ,give a single bacteria cell (germination).

Function : They make survival of organism possible under un-favorable condition like dry state. Spores are resistant to heat ,drying , freezing, and toxic chemicals.



Nutrition in Bacteria

Bacteria exhibit different modes of nutrition. On this basis, broadly ***two types of bacteria*** can be recognized autotrophic bacteria and heterotrophic bacteria.

THE TYPE ONE : *Autotrophic Bacteria*

These are bacteria which are able to synthesize their own organic food from inorganic substances. They use carbon dioxide for obtaining carbon and utilize hydrogen sulphide (H_2S) or ammonia (NH_3) or hydrogen (H_2) as the source of hydrogen to reduce carbon. These bacteria can be distinguished further into two types as follows:

A- *Photoautotrophic Bacteria*

The photoautotrophic bacteria possess photosynthetic pigments in membrane bound lamellae (or thylakoids) and utilize solar energy. The bacterial photosynthesis is different from that of green plants since here water is not used as a hydrogen donor. Hence oxygen is not released as a byproduct. For this reason, the process is described as un oxygenic photosynthesis.

B- *Chemosynthetic Bacteria*

These are bacteria which manufacture organic compounds from inorganic raw materials utilising energy liberated from the oxidation ofinorganic substances. Following are **the common types of chemo autotrophic bacteria.**

1- **Nitrifying bacteria** which derive energy by oxidizing ammonia into nitrates. Eg: Nitrosomonas , Nitrobacter.

2- **Sulphur bacteria** which derive energy by oxidising hydrogen sulphide to sulphur. Eg: Thiobacillus , Beggiatoa

3- **Iron Bacteria** which derive energy by oxidising ferrous ions into ferric form. Eg: Ferrobacillus , Gallionella

THE TYPE TWO : Heterotrophic Bacteria

These are bacteria which are unable to manufacture their own organic food and hence are dependent on external source. These bacteria can be distinguished **into three groups as follows:**

A-Saprophytic Bacteria: These bacteria obtain their nutritional requirements from dead organic matter. They breakdown the complex organic matter into simple soluble form by secreting exogenous enzymes. Subsequently they absorb the simple nutrients and assimilate them, during which they release energy. These bacteria have a significant role in the ecosystem, functioning as decomposers.

B-The aerobic breakdown of organic matter is called as decay or decomposition. It is usually complete and not accompanied by the release of foul gases. Anaerobic breakdown of organic matter is called fermentation. It is usually incomplete and is always accompanied by the release of foul gases. Anaerobic breakdown of proteins is called putrefaction.

C-The property of decomposition of organic compounds is employed in several industrial processes such as ripening of cheese, in the retting of fibres and in the curing of tobacco.

Symbiotic Bacteria

These are bacteria which occur in the body of animals and plants, obtaining their organic food from there. Most of these bacteria are pathogenic, causing serious diseases in the host organisms either by exploiting them or by releasing poisonous secretions called toxins


Thank you