Laboratory Module A:
Advanced Food Microbiology

Dr. Md. Abdus Shabur Talukder

PhD (Japan)

Food Microbiologist

- ✓ Contributes to the knowledge about the behavior of microorganisms in food and processing environments
- ✓ New products/Brand maintenance
- ✓ Conducts tests to verify shelf-life of new food products

Research Develops new and/or rapid testing methods

Studies "good" (those responsible for fermentation) and "bad" (those responsible for food borne illness) bacteria

Responsibilities

Experimental design

Perform, analyze, and report experimental results

Troubleshooting

Case Study: Juice

Food microbiologists validate the pasteurization of juice to ensure pathogens such as **E.coli** 0157:H7 will not survive and cause foodborne illness.

Case Study: Juice

Food microbiologists validate the pasteurization of juice to ensure pathogens such as E.coli 0157:H7 will not survive and cause foodborne illness.

A Brief History

- Early Food Preservation
- **900 AD** –"Food Poisoning" Recognized
- **1795**-Appert Developed Canning
- **1854-1864-FOOD MICROBIOLOGY BECOMES A SCIENCE**

Louis Pasteur

Why Study Food Microbiology?

- Provide Clean, Safe, Healthful Food to Consumer
- Food Permits Growth Control of Microbial Growth
- Prevent Food Spoilage
- Prevent Food-borne Illnesses
- Food Preservation and Production

Food-Borne Illness

ERS Estimates

$6.9 Billion/Year Cost of FBI

CDC Estimates

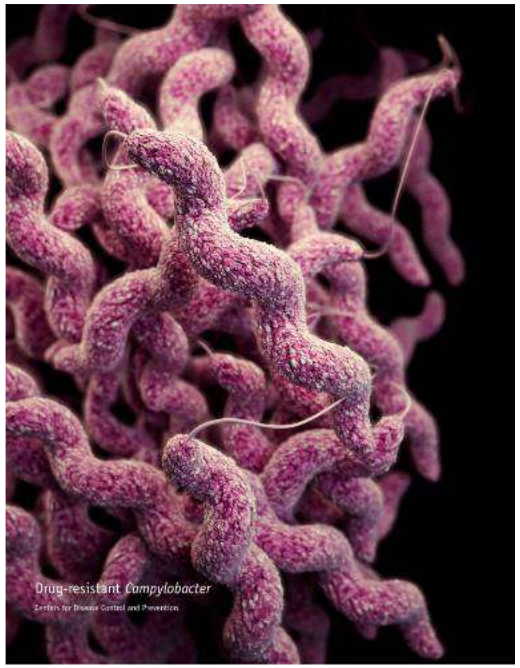
76 Million Cases of FBI Annually

325,000 Hospitalizations

5,000 Deaths

What Organism Causes the Most Cases of Food-Borne Illness Annually?

- **Campylobacter**



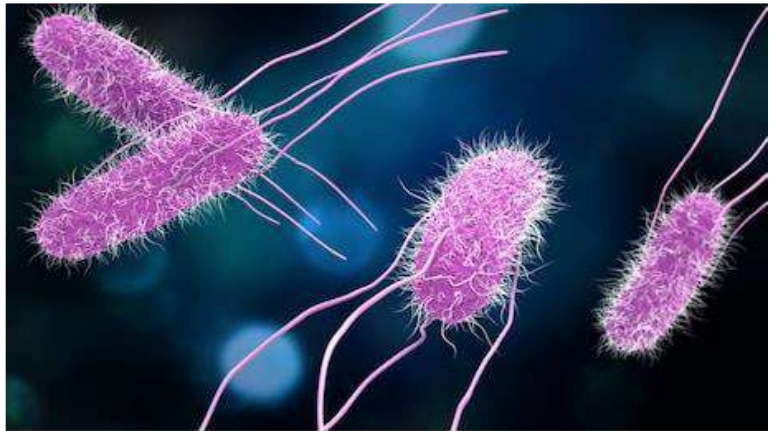
Campylobacter is a bacterium found in the intestines of many types of animals and is the most common bacterial cause of diarrhoeal illness.

What Organism Causes the Most Deaths Due to Food-Borne Illness?

Salmonella infection (**salmonellosis**) is a common bacterial disease that affects the intestinal tract.

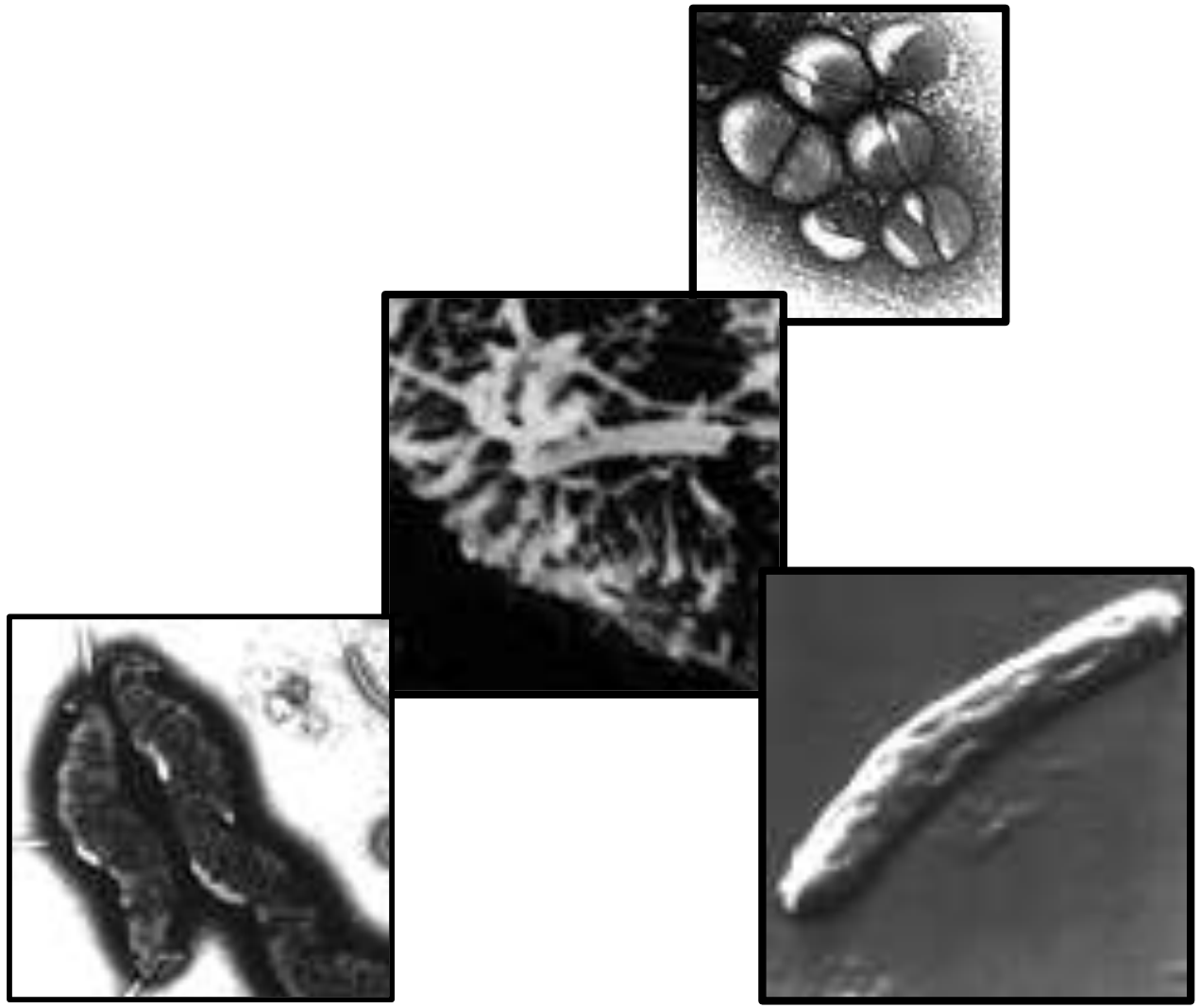
Salmonella bacteria typically live in animal and human intestines and are shed through feces. Humans become infected most frequently through contaminated water or food.

Salmonella



Review of Microbiology

- Mostly Single Celled
- Groups
- Morphologies
- Gram Reactions
- Size
- Growth Rate



The good, the bad and the ugly

Good-bacteria are important in food production

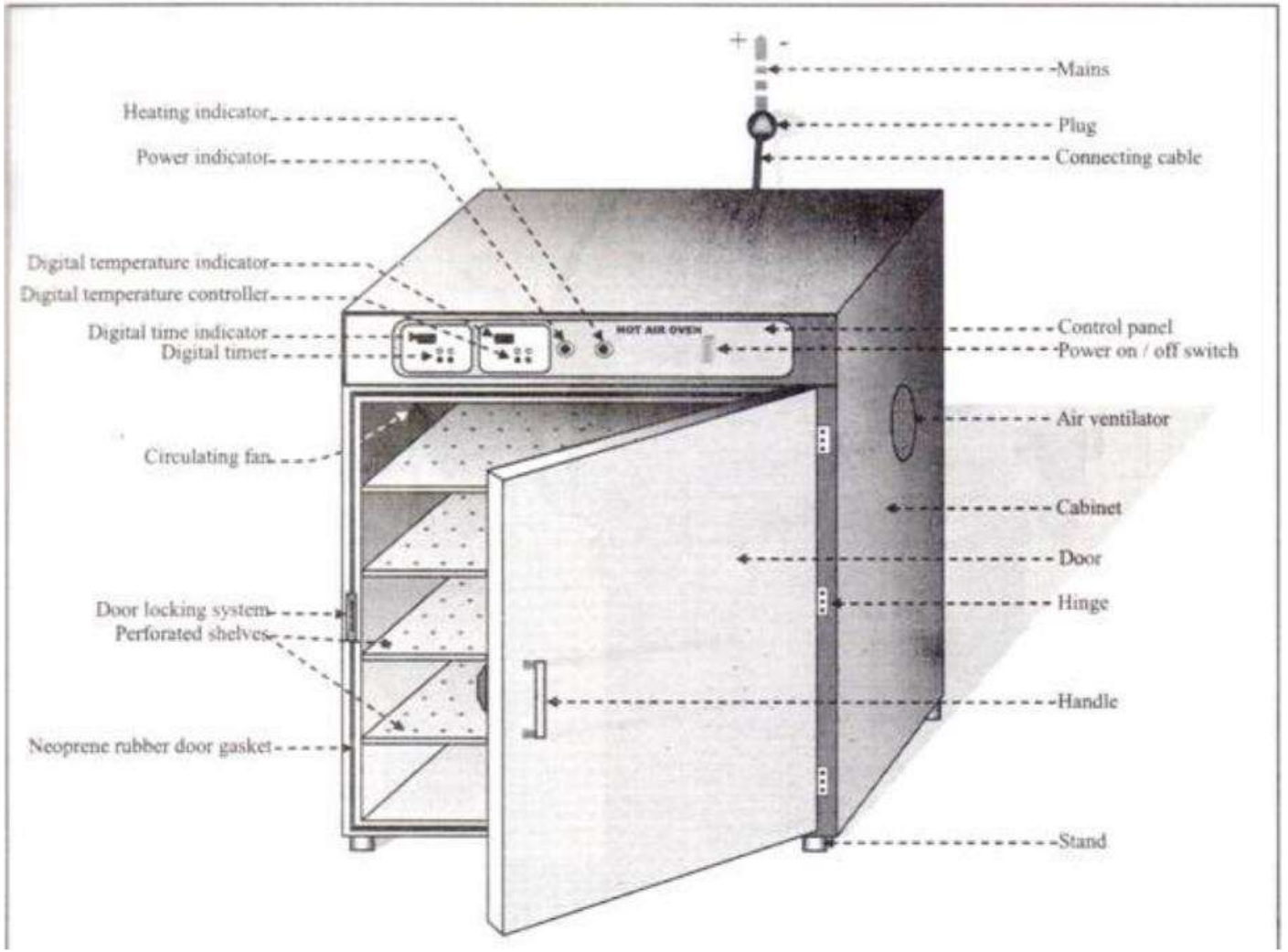
Bad-some bacteria cause food poisoning

Ugly-some bacteria cause food spoilage

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

1.Drying Oven:

For preparation of certain reagents, the glassware's, after proper cleaning and rinsing with distilled water, are required to be dried. They are dried inside the drying oven at 100°C till the glassware's dry up completely.



Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

- **Autoclaving** is a sterilization method that uses high-pressure steam. The **autoclaving** process works by the concept that the boiling point of water (or steam) increases when it is under pressure.

An **autoclave** is a pressure chamber used to sterilize equipment and supplies by subjecting them to high pressure saturated steam at 121 °C for around 15–20 minutes depending on the size of the load and the contents.

Autoclave

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Is a device used to grow and maintain microbiological cultures.

Incubator

The incubator maintains optimal temperature, humidity and other conditions such as the carbon dioxide (CO_2) and oxygen content of the atmosphere inside.

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Centrifuge

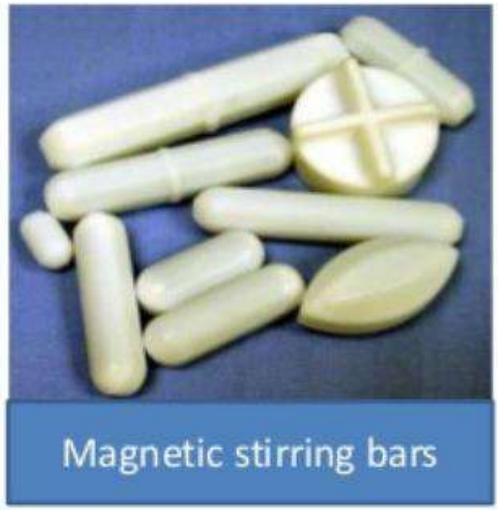
- is an apparatus that rotates at high speed and separates substances of different densities.

Lab. refrigerator

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

hot plate / stir plate

used to heat and stir substances.



Magnetic stirring bars

Balance

used to measure an object's mass to a very high degree of precision.

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Biological Safety Cabinets

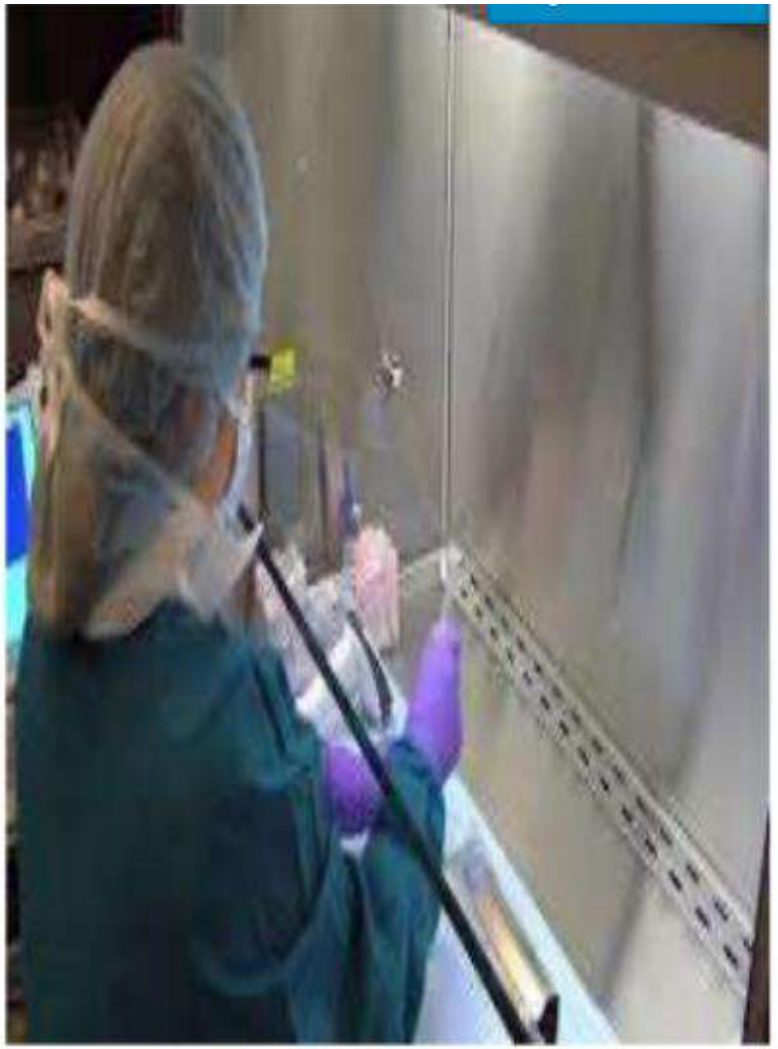
is an enclosed, ventilated laboratory workspace for safely working with materials contaminated with pathogens.

Water bath

is a device that maintains water at a constant temperature.

It is used in the microbiological laboratory for incubations.

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests



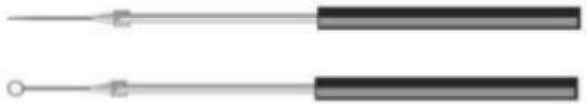
Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Inoculating loops and needles

Inoculating loops are used to transfer microorganisms to growth media or for staining slides.

The wire forms a small loop with a diameter of about 5 mm.

The loop of wire at the tip may be made of platinum or nichrome.

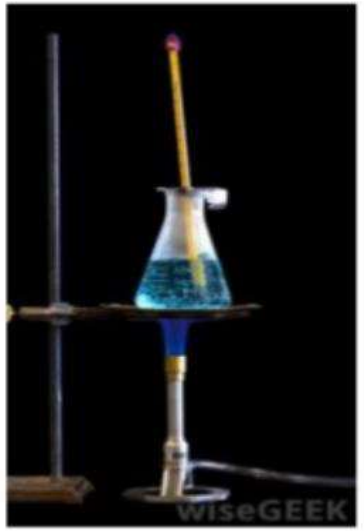


Needles are straight wires (no loop) used to pick up bacteria from closely packed colonies or to inoculate in a very defined area.

needles commonly used to inoculate semi-soft media.

Bunsen burner

is a common piece of laboratory equipment that produces a single open gas flame, which is used for heating and sterilization.



Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Anaerobic jar

is an instrument used in the production of an anaerobic environment.

This method of *anaerobiosis* is used to culture bacteria which die or fail to grow in presence of oxygen.

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Glassware

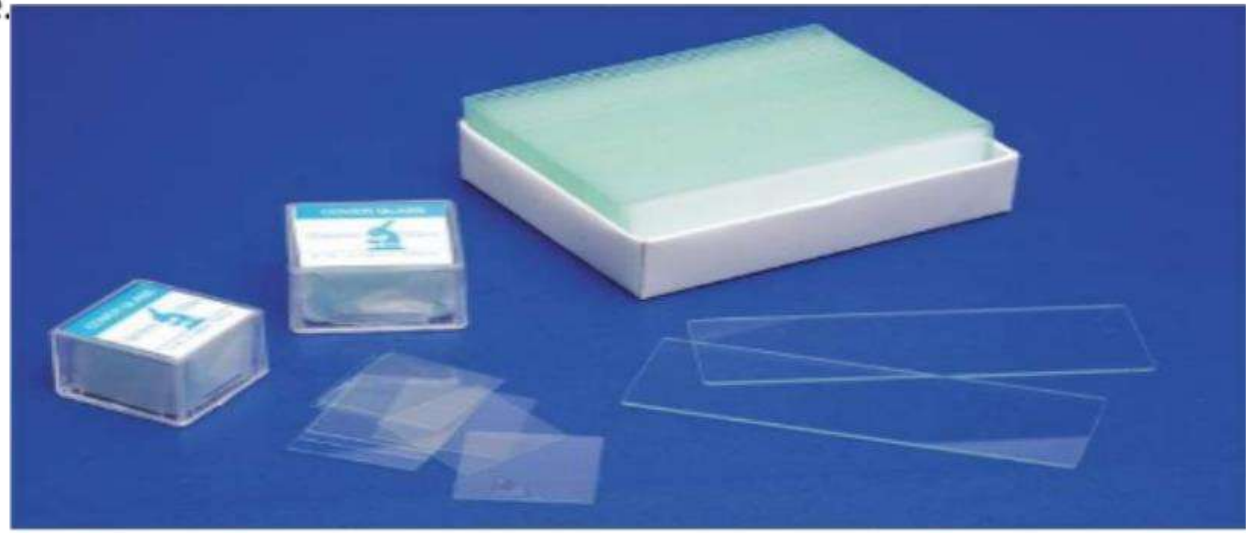
Glass slide and cover slip

- **Glass slide:**

used to place specimens on to observe under the microscope.

- **Cover slip:**

used to cover specimens on a microscope slide.



slide and coverslip

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Glassware

Petri dishes

often used to make **agar plates** for microbiology studies.

The dish is partially filled with warm liquid containing agar and a mixture of specific ingredients that may include:

nutrients

blood

salts

Carbohydrates

dyes

indicators

amino acids

or

antibiotics

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

Graduated Cylinders

Pipet

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

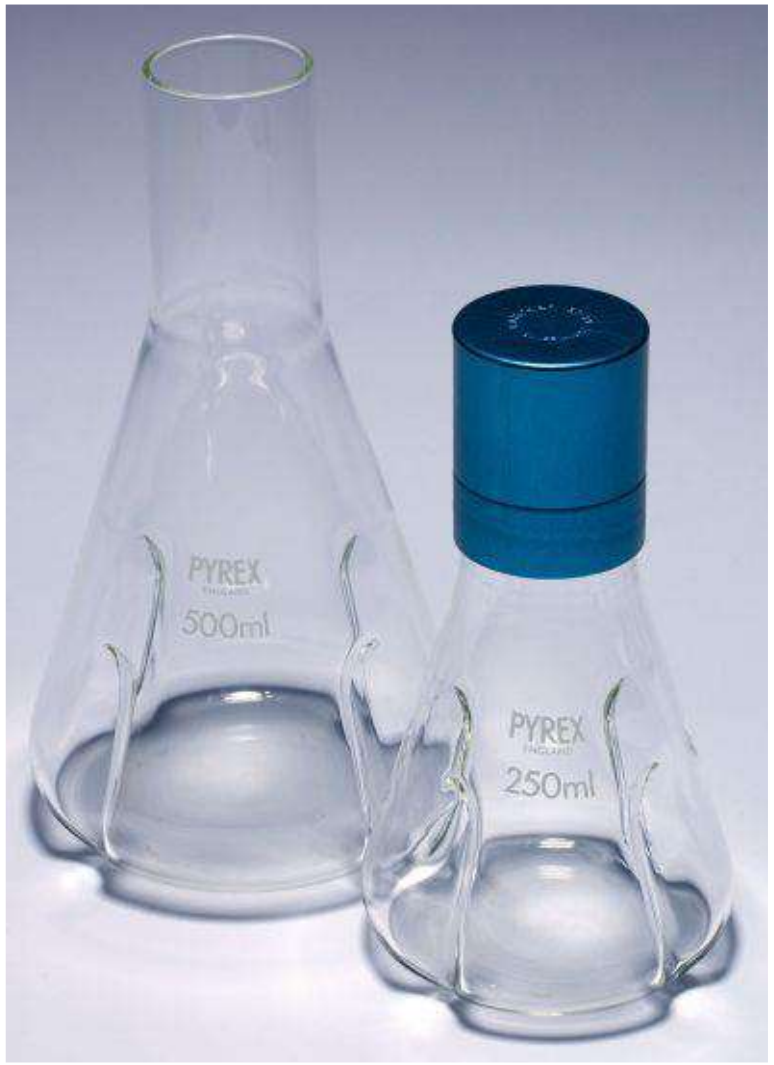
Glassware

Beaker

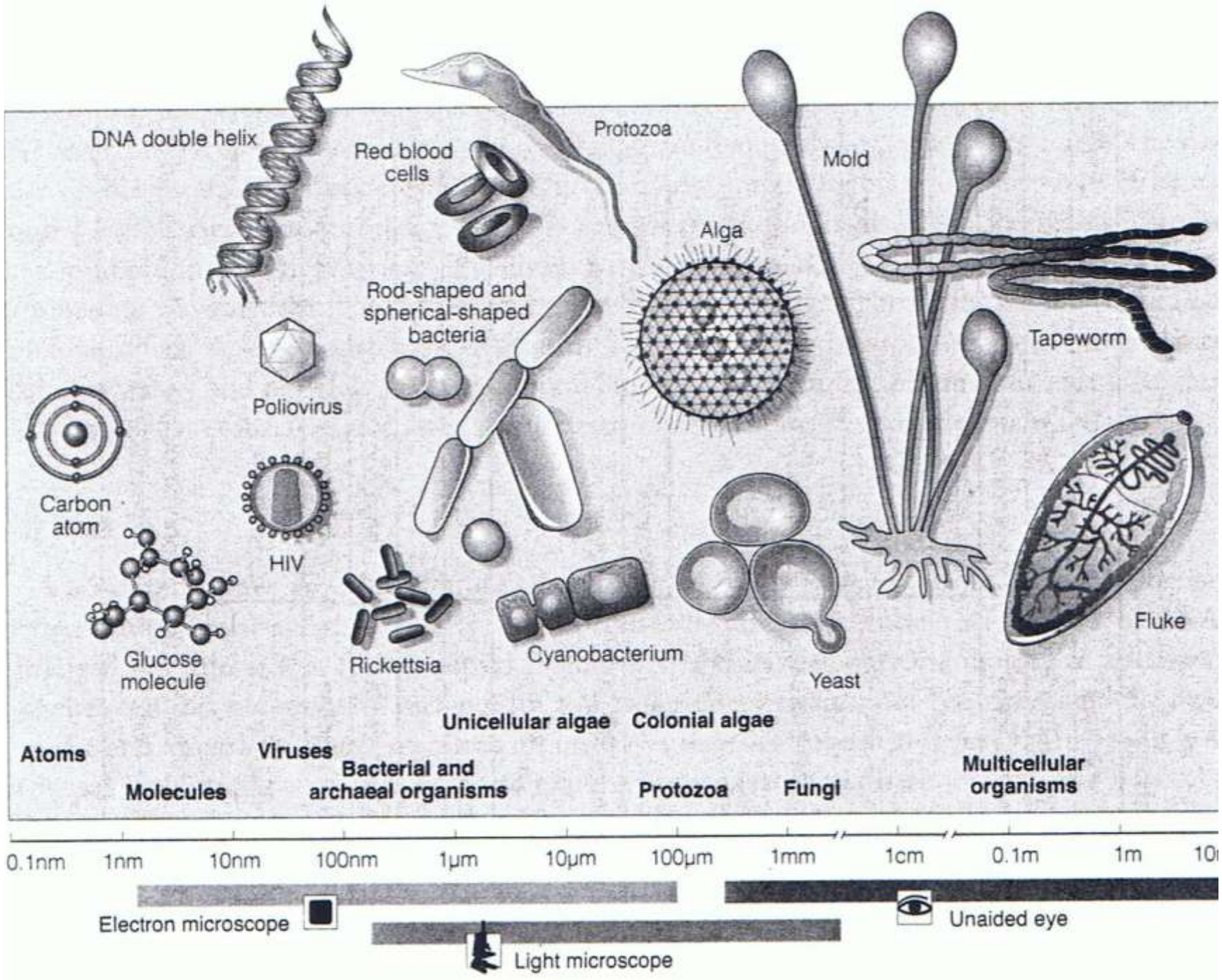
Glass or plastic

Used to stir, heat(if glass) and measure liquid volume in ml.

Experiment no.1: How to handle the instruments in microbiology lab.
Experiment no.2: Different microbial culture media.
Experiment no.3:Catalase, Oxidase and other common tests

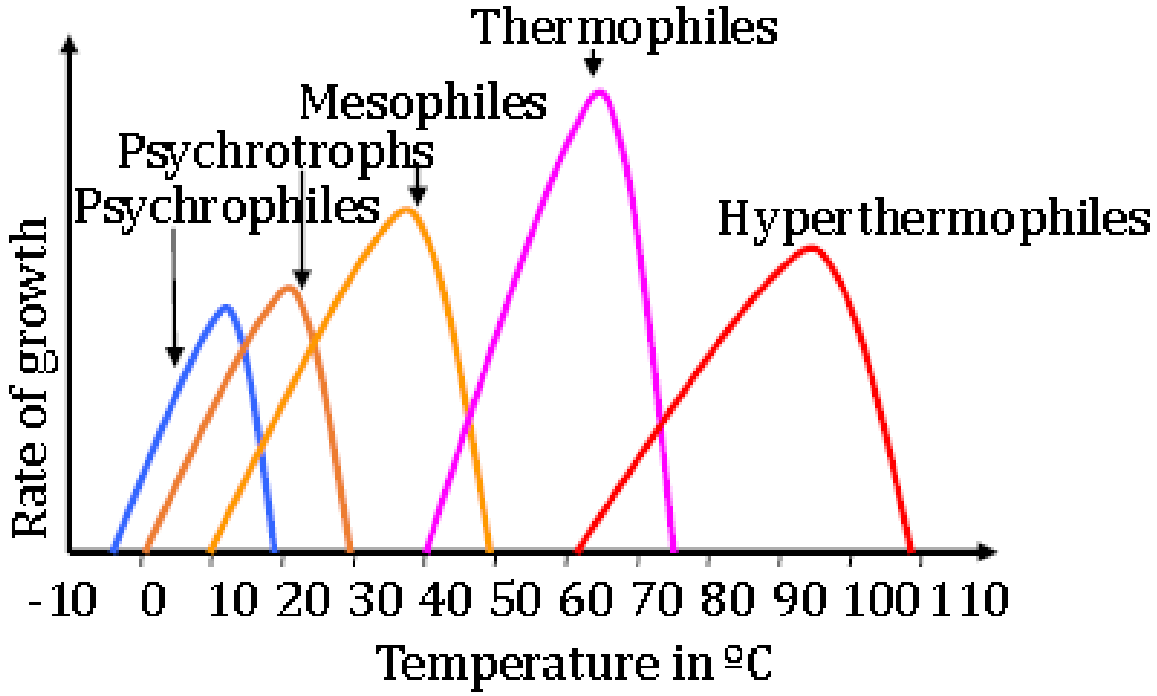


Buffled Flasks


DNA double helix
Red blood cells
Protozoa
Mold
Alga
Rod-shaped and spherical-shaped bacteria
Tapeworm
Poliovirus
Carbon atom
HIV
Glucose molecule
Rickettsia
Cyanobacterium
Yeast
Fluke
Unicellular algae
Colonial algae
Atoms
Viruses
Bacterial and archaeal organisms
Molecules
Protozoa
Fungi
Multicellular organisms
0.1nm
1nm
10nm
100nm
1μm
10μm
100μm
1mm
1cm
0.1m
1m
Electron microscope
Unaided eye
Light microscope

Growth requirements

- **Physical**
  - Temperature
  - pH
  - Osmotic pressure
  - Moisture & desiccation
- **Chemical**
  - Carbon source
  - Nitrogen, sulfur phosphorus
  - Oxygen



Temperature

- **Psychrophiles (cold loving)**

•True psychrophiles

(optimum growth at 15 ºC)

•Psychrotophs

(optimum growth at 20-30 ºC)

- **Mesophiles** (moderate temperature loving)
- **Thermophiles** (heat loving)
- **Hyperthermophiles** (tolerate extreme temperatures)

Most pathogenic bacteria are mesophiles And grow optimally at 37ºC (human body temperature)

pH

- Most medically important bacteria grow at **neutral or slightly alkaline pH (7.2 to 7.6)**
- Very few bacteria grow below pH 4
- Lactobacilli grow in acidic pH; cholera *vibrio* grow in alkaline pH
- Growth media includes chemical buffers to prevent acid production
- Foods are preserved by acids produced by bacterial fermentation

Moisture and desiccation

- Moisture is essential -80% body weight is water
- Effect of drying varies by organism

  ***T pallidum*, gonococcus are very susceptible**

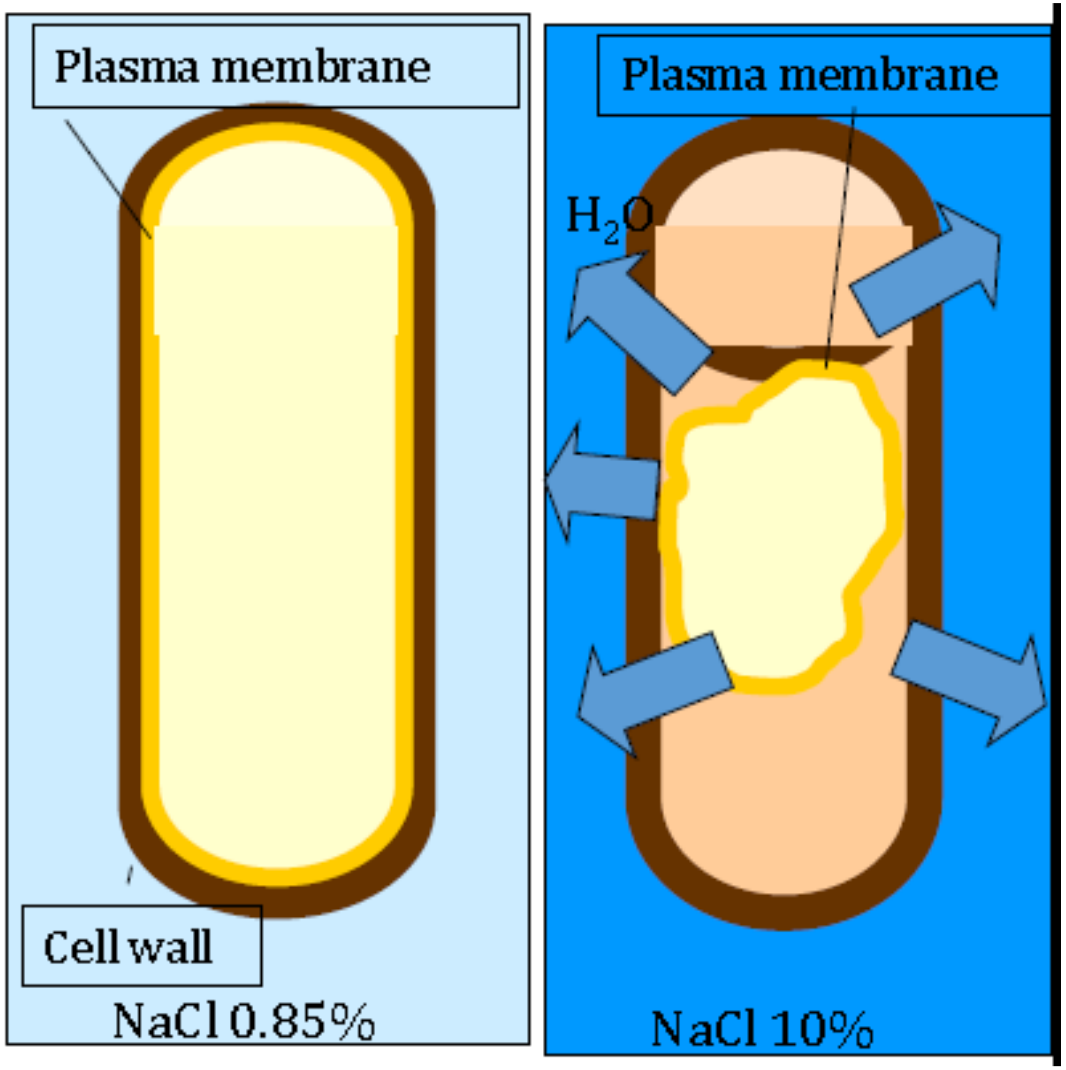
  Tubercle bacilli, staphylococci may survive for weeks

  Bacterial spores survive several years
- Lyophilization

  Freeze dry process that protects bacteria

Osmotic pressure

- High osmotic pressure (hypertonic) removes water causing plasmolysis – inhibits growth i.e. salt as preservative
- Low osmotic pressures (hypotonic) cause water to enter and can cause lysis
- Bacteria are more tolerant to osmotic variations because of the mechanical strength of the cell wall



Oxygen

- Obligate aerobes

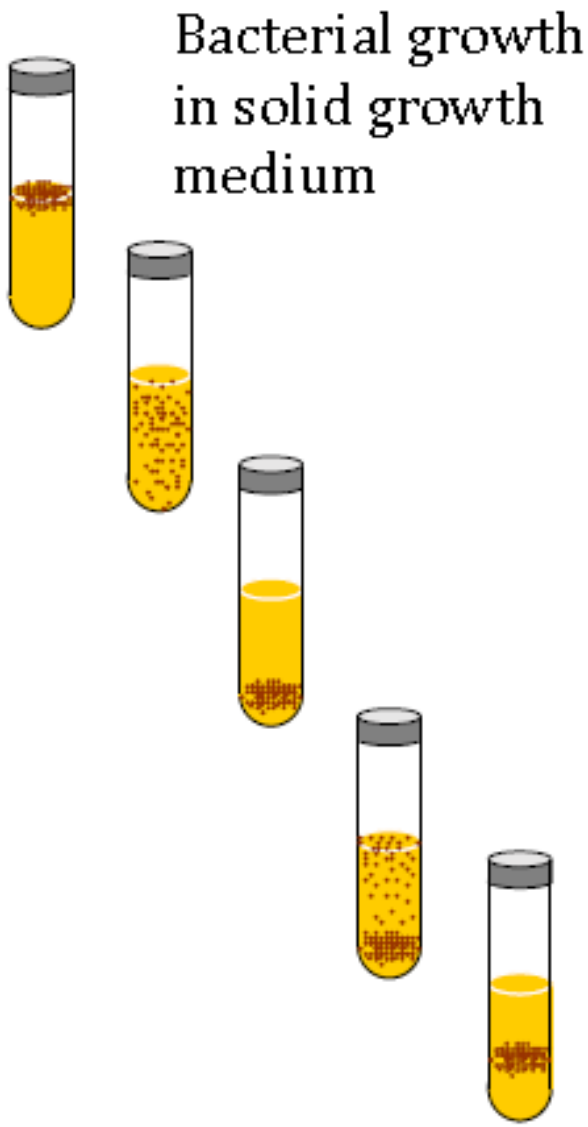
  Only aerobic growth, oxygen required
- Facultative anaerobes (most human pathogens)

  Greater growth in presence of oxygen
- Obligate anaerobes

  Only anaerobic growth, cease with oxygen
- Aero tolerant anaerobes (e.g., *C. perfringens*)

  Only anaerobic growth, continues with oxygen
- Microaerophiles (e.g., *M. tuberculosis*)

  Only aerobic growth with little oxygen



Thank you