



Introduction to Microbiology

Pharmaceutical Microbiology

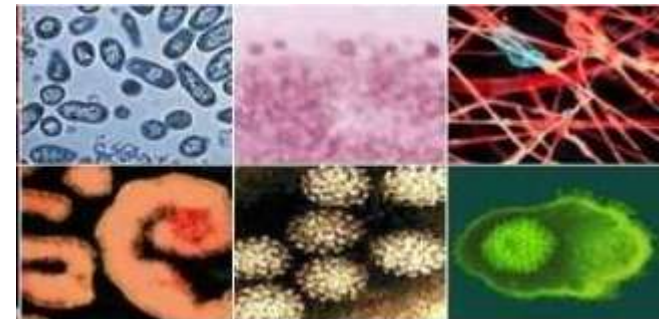
Dr. Rawan Abudalo

Department of Clinical Pharmacy and Pharmacy Practice
Faculty of Pharmaceutical Sciences
Hashemite University

What is Microbiology

- Microbiology is the study of organisms or agents too small to be seen with naked eyes.
- Microorganisms are present everywhere. They present in soil, air and water.

1. Microorganisms are very small organisms which cannot be seen with the unaided eye. They can be seen only with a magnifying glass or microscope.
2. Microorganisms may be unicellular or multicellular.
3. Microorganisms may exist alone or in colonies.
4. Microorganisms are found in all kinds of They are also found inside the bodies of other organisms



Microorganisms

- Some organisms studies by microbiologists CAN be visualized without the aid of amplification [bread molds (fungus) and filamentous algae]
- These organisms are included in the discipline of microbiology because of similarities in properties and techniques used to study them
- Techniques necessary to **isolate and culture microorganisms**:
 - Isolation
 - Sterilization
 - Culture in artificial media





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

- causing disease
- causing food spoilage

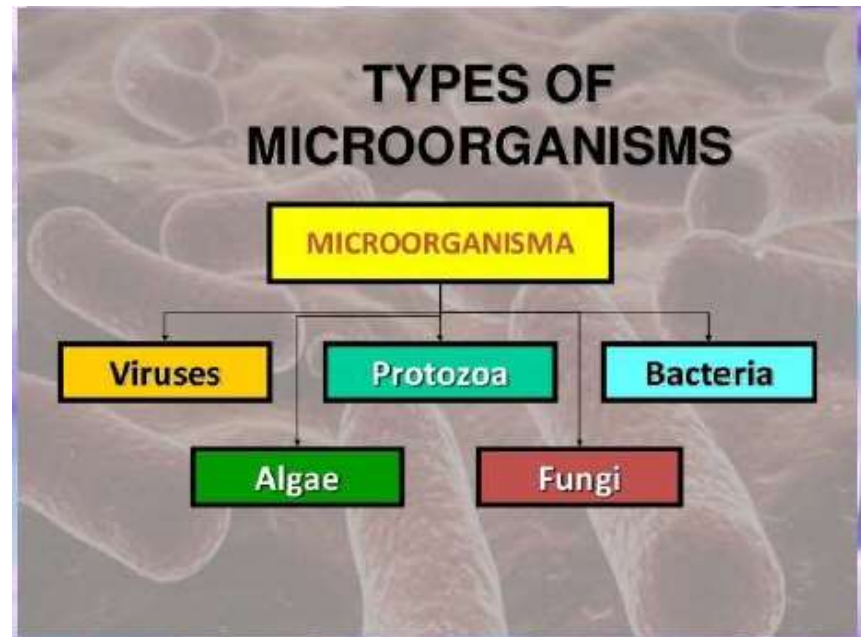
Why is microbiology important?

- Applied aspects are concerned with practical problems. These are:
- Disease study.
- Water and waste water treatment.
- Food spoilage and food production.
- Industrial uses of microbes.

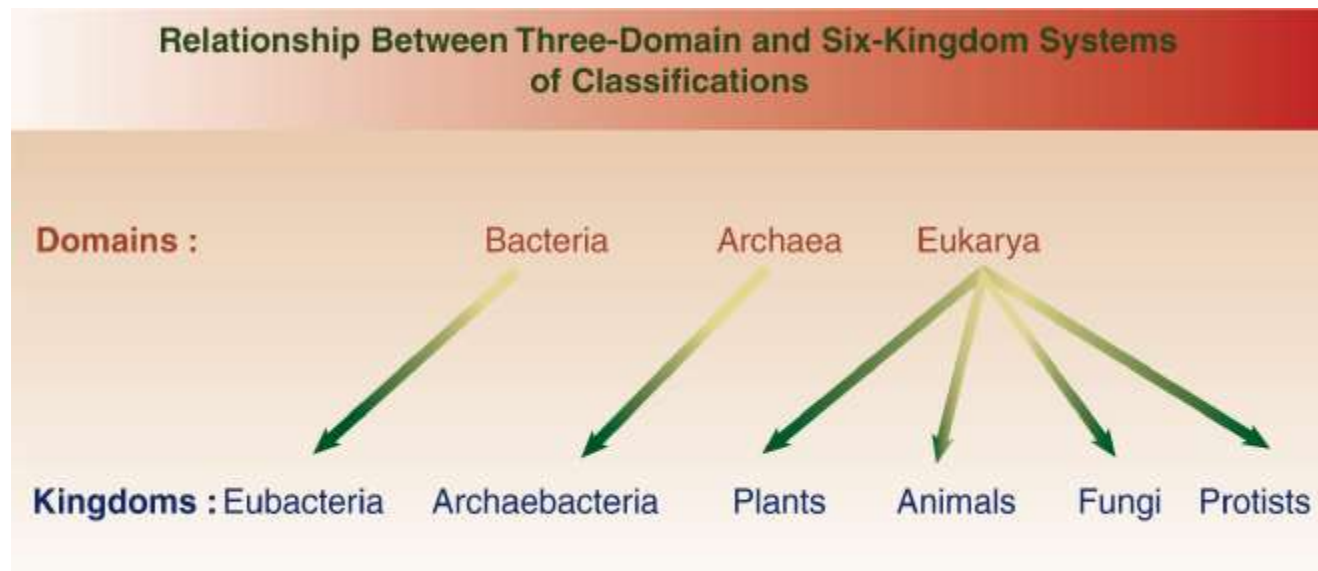
Types of microorganisms

They are :

- bacteria, fungi, algae and protozoans.
- Viruses are also considered as microorganisms. They are different from other microorganisms because they reproduce only in the body of host

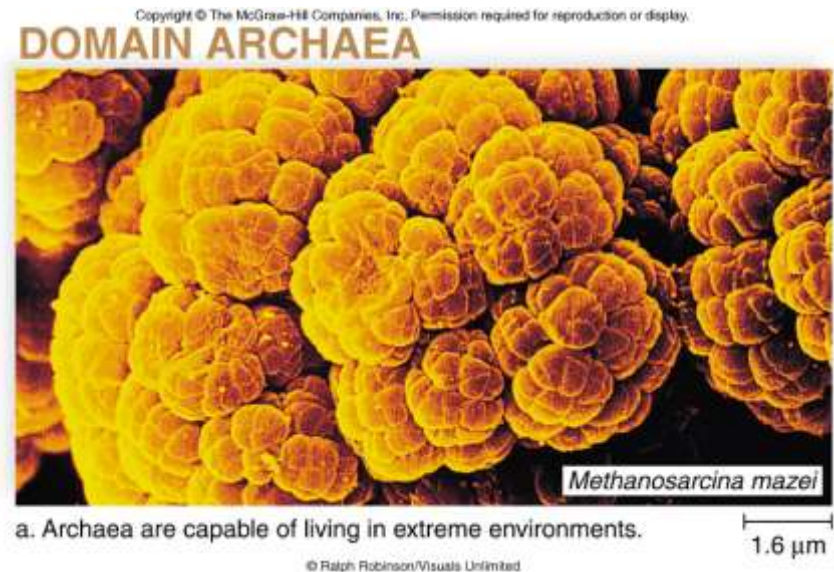


The highest – largest category, recent addition 3 domains



Domains

1. Archaea – ancient “bacteria”, unicellular like bacteria, also simple cell structure (prokaryote – no nucleus) but have distinct metabolism (chemistry) allowing them to exist in “extreme” environments



Domain Bacteria

2-Bacteria are single- celled organisms that lack a membrane-bound nucleus. (Prokaryote also)

- Bacteria are found almost everywhere on the planet Earth.



Domain Eukarya

3. Eukarya – unicellular to multicellular, complex and organized cells with nuclei and organelles (mitochondria)

Eukarya are further categorized into one of four Kingdoms.
(know these kingdoms)

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DOMAIN EUKARYA

Kingdom	Organization	Type of Nutrition	Representative Organisms				
Protista	Complex single cell, some multicellular	Absorb, photosynthesize, or ingest food	 paramecium	 euglenoid	 slime mold	 dinoflagellate	Protozoans, algae, water molds, and slime molds
Fungi	Some unicellular, most multicellular filamentous forms with specialized complex cells	Absorb food	 black bread mold	 yeast	 mushroom	 bracket fungus	Molds, yeasts, and mushrooms
Plantae	Multicellular form with specialized complex cells	Photosynthesize food	 moss	 fern	 pine tree	 nonwoody flowering plant	Mosses, ferns, nonwoody and woody flowering plants
Animalia	Multicellular form with specialized complex cells	Ingest food	 sea star	 earthworm	 finch	 raccoon	Invertebrates, fishes, reptiles, amphibians, birds, and mammals

c. Eukaryotes are divided into four kingdoms.

History of microbiology

□ **Anton van Leeuwenhoek (1632–1723):** was the first microbiologist and the first person to observe bacteria using a single-lens microscope of his own design.

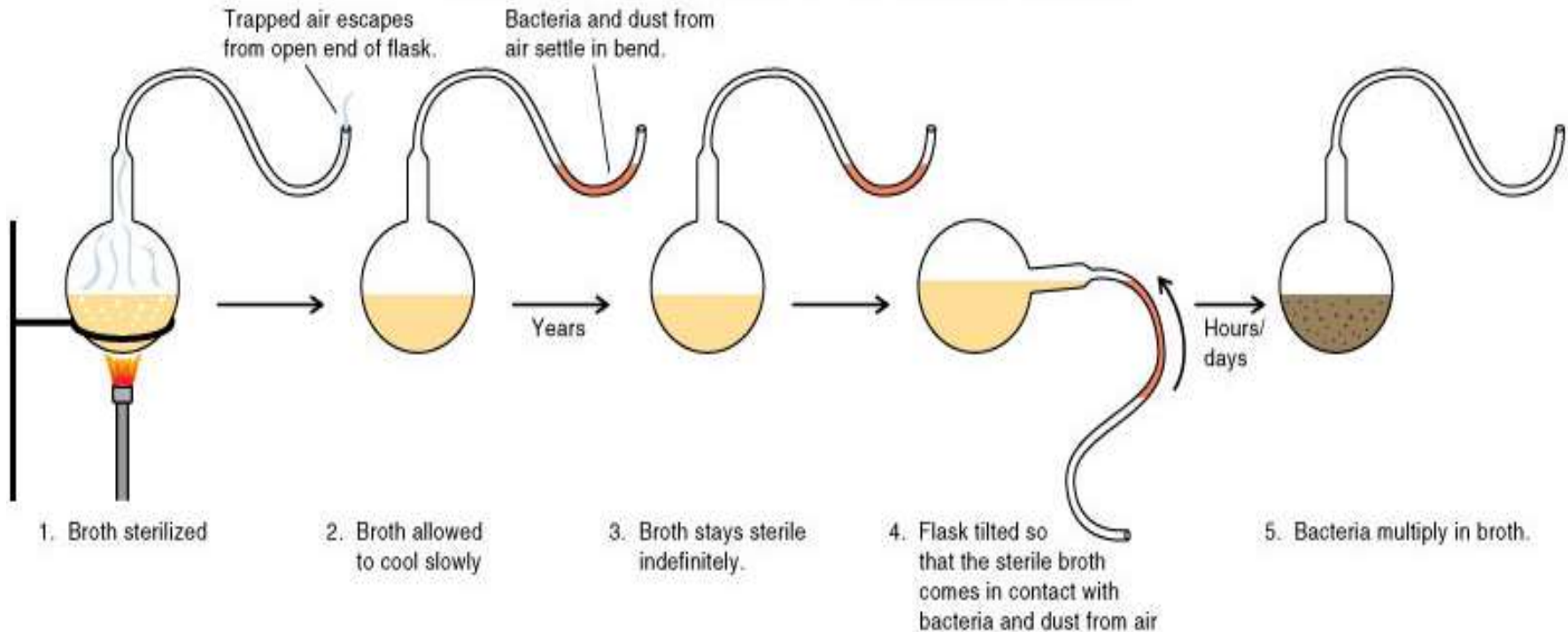
□ **Louis Pasteur (1822–1895):** Pasteur developed a process (today known as pasteurization) to kill microbes. pasteurization is accomplished by heating liquids to 63 to 65 °C for 30 minutes or to 73 to 75 °C for 15 seconds.

LOUIS PASTEUR (1822 - 1895)



- Disproved spontaneous generation of microbes by preventing “dust particles” from reaching the sterile broth
- In 1861 completes experiments that lays to rest spontaneous generation.
- Showed microbes caused fermentation and spoilage
- Considered by many as “Father of Microbiology”

PASTEUR'S EXPERIMENT



Pasteur's swan-necked flasks. Broth solutions rich in nutrients were placed in flasks and boiled. The necks of the flasks were heated and drawn out into a curve, but kept open to the atmosphere. Pasteur showed that the broth remained sterile because any contaminating dust and microorganisms remained trapped in the neck of the flask as long as it remained upright.

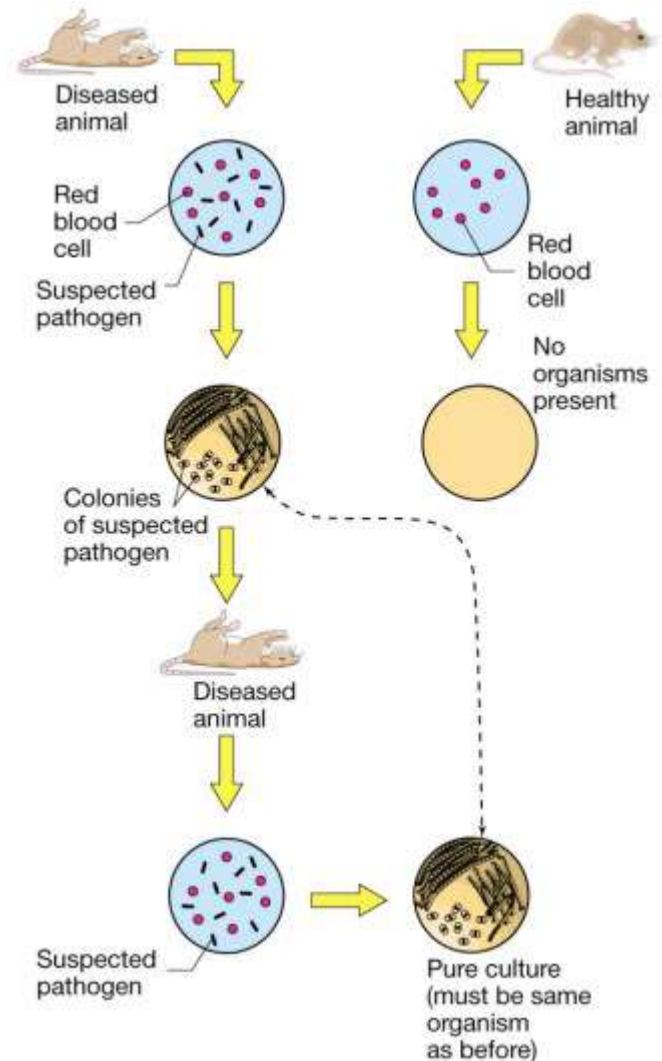
Demonstrations that microorganisms cause disease: **Germ theory**

❑ **Robert Koch (1843–1910):** was a pioneer in medical microbiology and worked in cholera, anthrax and tuberculosis. He was awarded a Nobel prize in 1905 (Koch's postulates) he set out criteria to test.

- His criteria (is still used) to establish the link between a microorganism and a particular disease that it cause, is known as Koch's postulates.

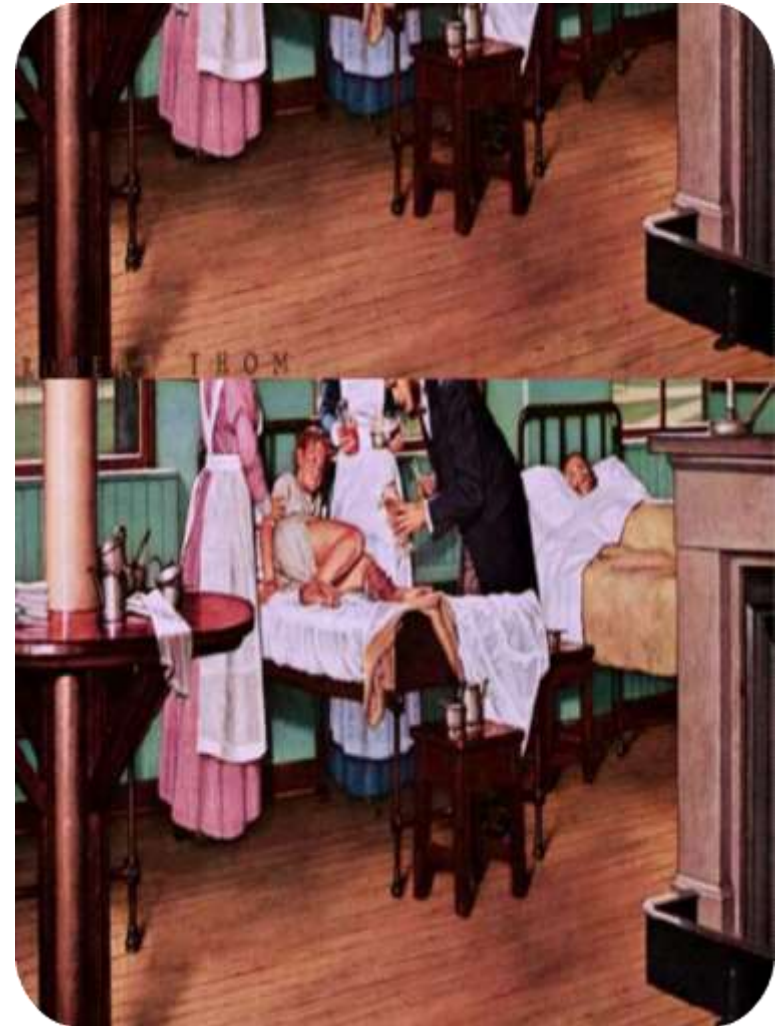
Koch's Postulates

- 1 The microorganism must be present in every instance of the disease and absent from healthy individuals.
- 2 The microorganism must be capable of being isolated and grown in pure culture.
- 3 When the microorganism is inoculated into a healthy host, the same disease condition must result.
- 4 The same microorganism must be re-isolated from the experimentally infected host.



History of Microbiology – Aseptic Technique- Joseph Lister

- He is popularly known as “Father of antiseptic surgery”.
- He was deeply interested in the prevention of postoperative sepsis.
- He was attracted by Pasteur’s germ theory of disease and concluded that sepsis or wound infection may be due to microbial growth derived from the atmosphere.



ALEXANDER FLEMING

In 1928 **Fleming** observed that the growth of the bacterium *staphylococcus aureus* was inhibited in the areas surrounding the colony of a mold that had contaminated a Petri plate. The mold was identified as *Penicillium notatum*, and its active compound was named penicillin.

Flemming and Penicillium



Naming and Classifying microorganisms

- Linnaeus system for scientific nomenclature
- Each organism has two names:
 - 1) Genus
 - 2) Specific epithet

Scientific Names

- Italicized or underlined.

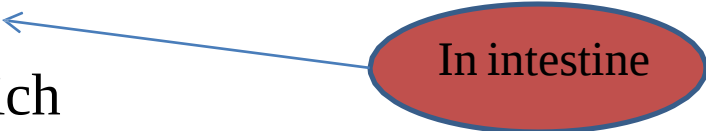
The genus is capitalized, and the specific epithet is with lowercase

- Could be as an honor for the scientist

- A Latin origin

e.g. *Escherichia coli* (*E. coli*)

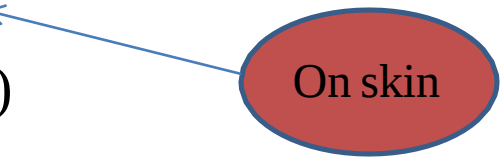
- discoverer: Theodor Escherich
- describes the habitat (colon/intestine)



In intestine

e.g. *Staphylococcus aureus* (*S. aureus*)

- Clustered (staphylo), spherical (cocci)
- Gold colored colonies (aureus)

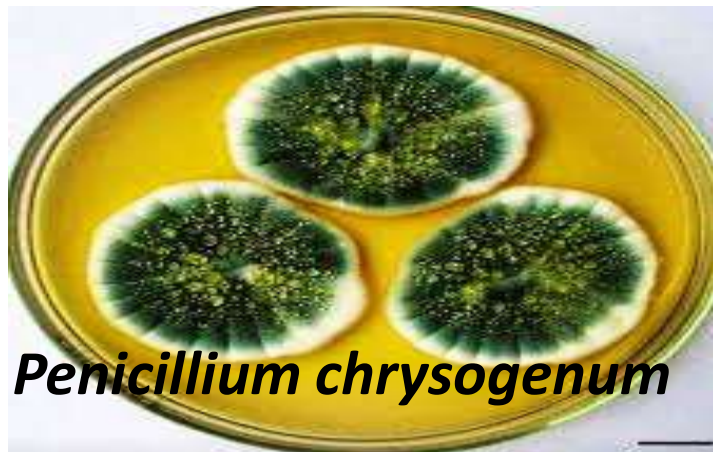
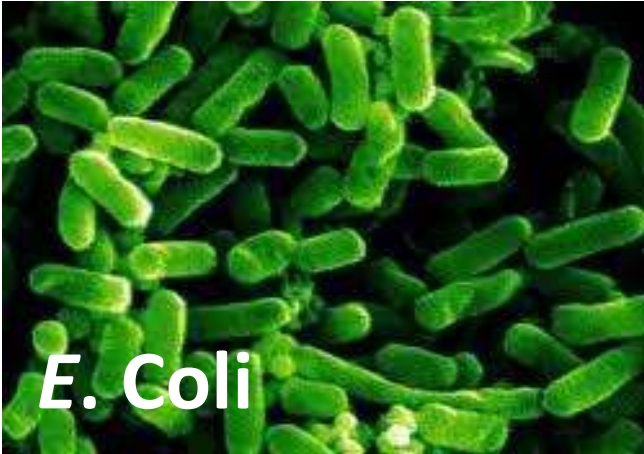


On skin

Scientific Names

Scientific Binomial	Source of Genus Name	Source of Specific Epithet
<i>Klebsiella pneumoniae</i>	Honors Edwin Klebs	The disease
<i>Streptococcus pyogenes</i>	Chains of cells (<i>strepto-</i>)	Forms pus (<i>pyo-</i>)
<i>Penicillium chrysogenum</i>	Tuftlike (<i>penicill-</i>)	Produces a yellow (<i>chryso-</i>) pigment
<i>Trypanosoma cruzi</i>	Corkscrew-like (<i>trypano-</i> , borer; <i>soma-</i> , body)	Honors Oswaldo Cruz

Scientific Names



Scientific Names

Genera named after individuals:

Escherichia coli: Theodore escherich invented the bacteria which causes disease in colon.

Neisseria gonorrhoea: Albert Neisser discovered the bacteria which causes gonorrhoea.

Scientific Names

Genera named after Microbe's shape:

Vibrio cholerae:

Bacteria is comma shaped which causes cholera.

Staphylococcus epidermidis:

Staphylo means clusters; coccus means spheres.

Genera named after Attribute of the Microbe:

Saccharomyces cerevisiae:

Saccharo means sugar; Myces means fungus; cerevisiae means beer. yeast which converts sugar in the sample into Alcohol.

How do we view microorganisms?

- Units of measurement

When talking about cells and microscopic organisms, you would be measuring using **MICROMETRE** (abbreviated: μ --micron) or stated as: μm (micrometer).

$$1 \mu\text{m} = 1 \times 10^{-6} \text{ meters} / 1 \times 10^{-3} \text{ mm}$$

$$1 \text{ mm} = 1 \times 10^6 \text{ nanometers} / 1 \times 10^3 \mu\text{m}$$

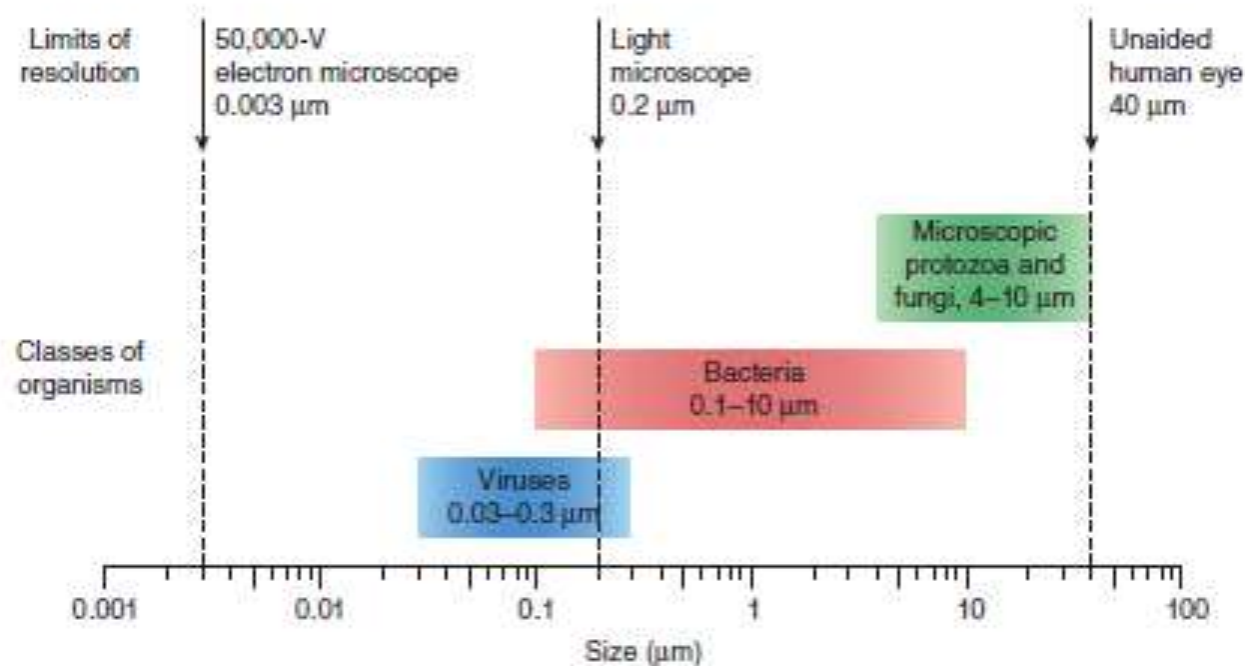
To give you the idea of how small a micro metre is,

1- a human hair is about $100 \mu\text{m}$, wide,

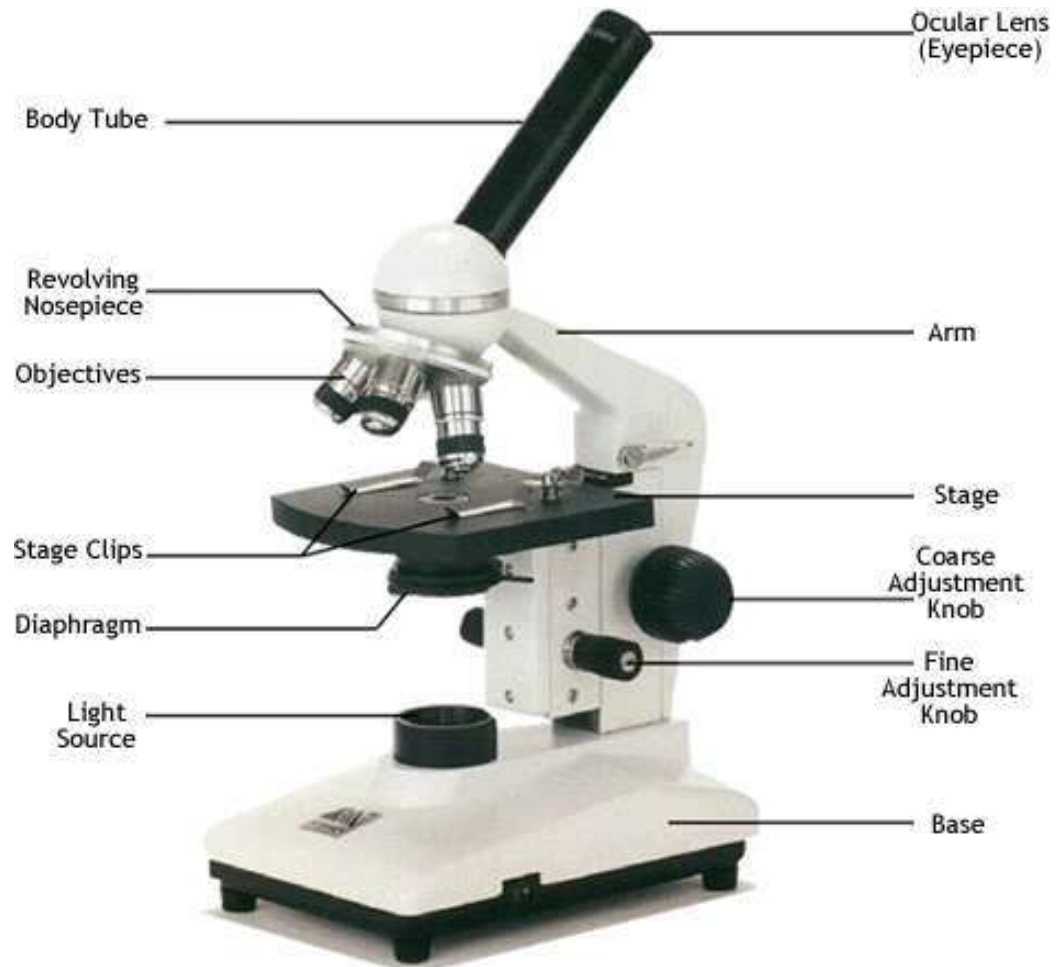
2 a red blood cell would be around $8 \mu\text{m}$ wide

3 typical size of an animal cell would be from $10 - 100 \mu\text{m}$

Relative size of microorganisms.



Microscope



Parts of the Microscope

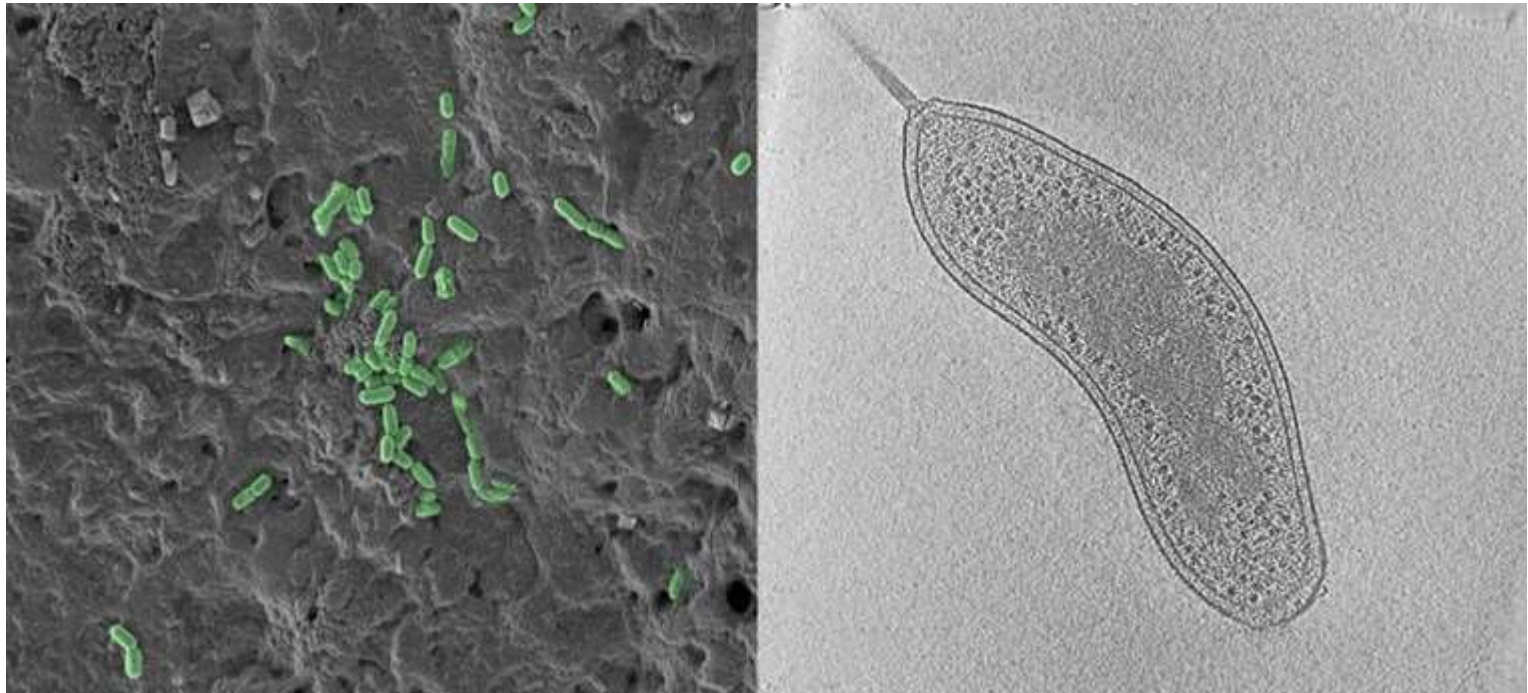
Parts	Functions
Eyeiece	To observe specimen. Contains two or more lenses. The most common magnification for the eyepiece is 10X. There are also 2x and 5x. An eye piece is a removable, can be interchanged for different magnification.
Objective Lenses	More than one objective lenses. These are the primary lenses of a compound microscope and can have specific magnification
Stage	The platform below the objective lens on which the object to be viewed is placed. A hole in the stage allows light beam to pass and illuminate the specimen.
Stage Clips	There are two stage clips one on each side of the stage. Once the slide containing the specimen is placed on the stage, the stage clips are used to hold the slide in place.
Diaphragm	It is located on the lower surface of the stage. It is used to control the amount of light that reaches the specimen through the hole in the stage.
Illuminator	is the light source for a microscope , typically located in the base of the microscope . Most light microscopes use low voltage, halogen bulbs with continuous variable lighting control located within the base.
The Adjustments	2 adjustment knobs: fine adjustment & coarse adjustment knob; refine the focus of the lenses. The coarse adjustment knob helps in improving the focus of the low powers whereas the fine adjustment knob helps in adjusting the focus of the lenses with higher magnification.

Types of Microscopes

Light Microscope - found in most schools, use compound lenses and light to magnify objects. The lenses bend or refract the light, which makes the object beneath them appear closer.

Scanning Electron Microscope - allow scientists to view a universe too small to be seen with a light microscope. SEMs do not use light waves; they use electrons (negatively charged electrical particles) to magnify objects

Transmission Electron Microscope - also uses electrons, but instead of scanning the surface (as with SEM's) electrons are passed through very thin specimens. Specimens may be stained with heavy metal salts



SEM (left) and TEM (right) images of bacteria. Whereas SEM shows numerous bacteria on a surface (green), the TEM image shows the interior structure of a single bacterium