



اللهم وفقني في دراستي، ونور بالكتاب بصري، وشرح به
صدري، واستعمل به بدني، واطلق به لساني، وقوّ به عزمي
بحولك وقوتك، فإنه لا حول ولا قوة إلا بك يا أرحم الراحمين

كل ما في السلايدات مطلوب حفظه و الملخصات
المذكورة في الملف هي وسيلة لتسهيل ربط المعلومات و
تضمن ملاحظات حكتها الدكتورة

وفقكم الله...



Introduction to Microbiology

Pharmaceutical Microbiology

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- * The main problem that we care about is $\rightarrow$ resistance of drug
- * Causes of drug resistance :-
 - 1) Incomplete drug
 - 2) wrong drug
 - 3) Another drug affect on response of this drug
- * Resistance cause failure in treatment

What is Microbiology

- Microbiology is the study of organisms or agents too small to be seen with naked eyes.
 - $\rightarrow$ because they are so small, but some of small organism can be seen by naked eye such as: bread mold (fungus) & filamentous algae
- Microorganisms are present everywhere. They present in soil, air and water.

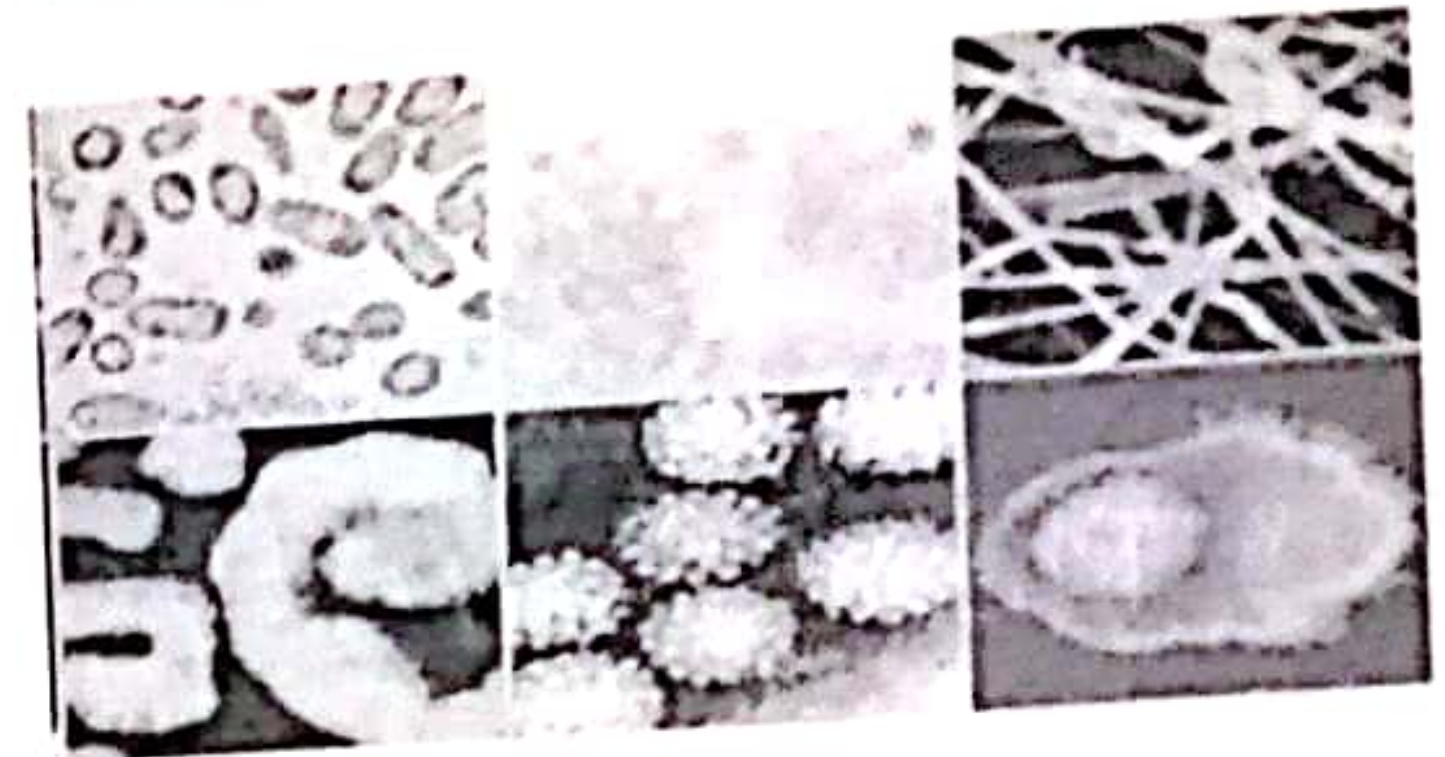
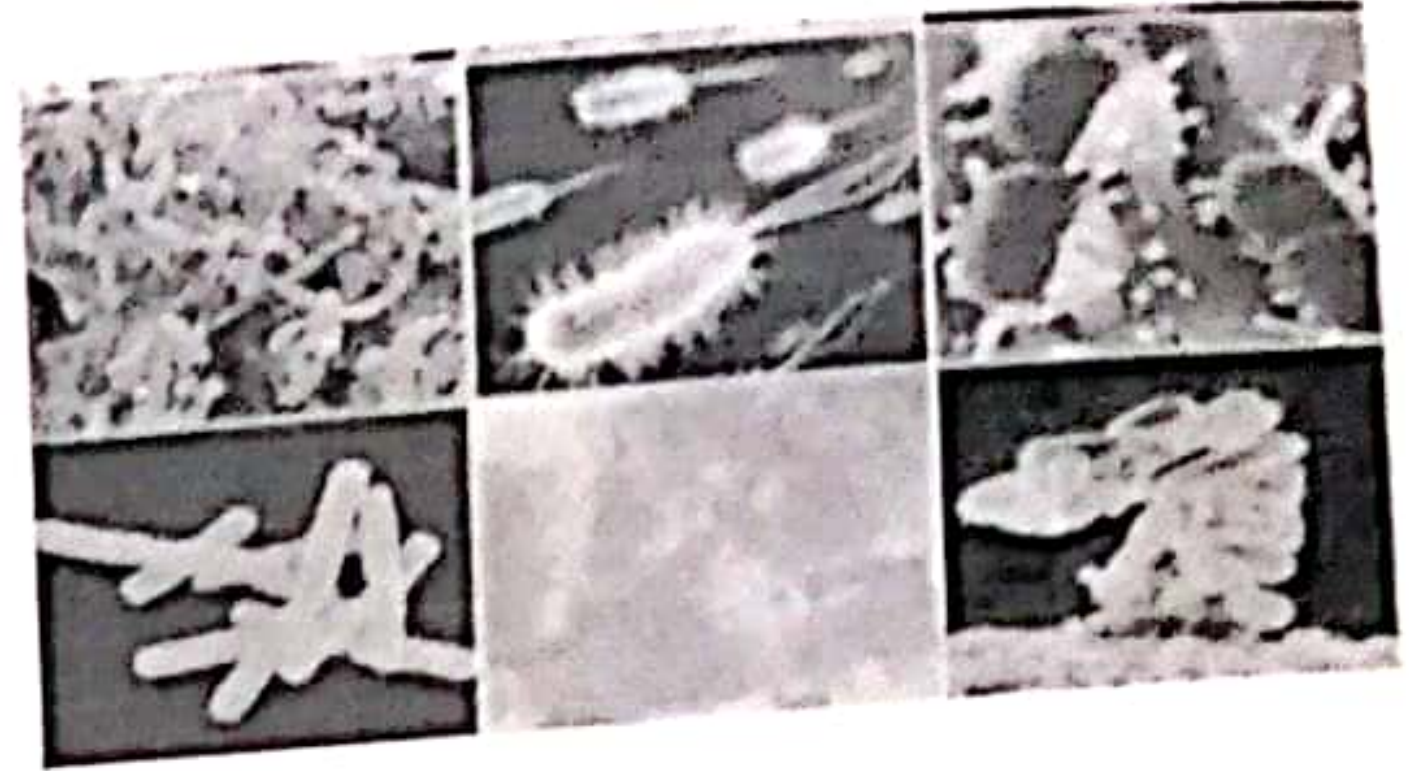
Micro $\rightarrow$ size is (very small size)
ology $\rightarrow$ indicate that is science

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



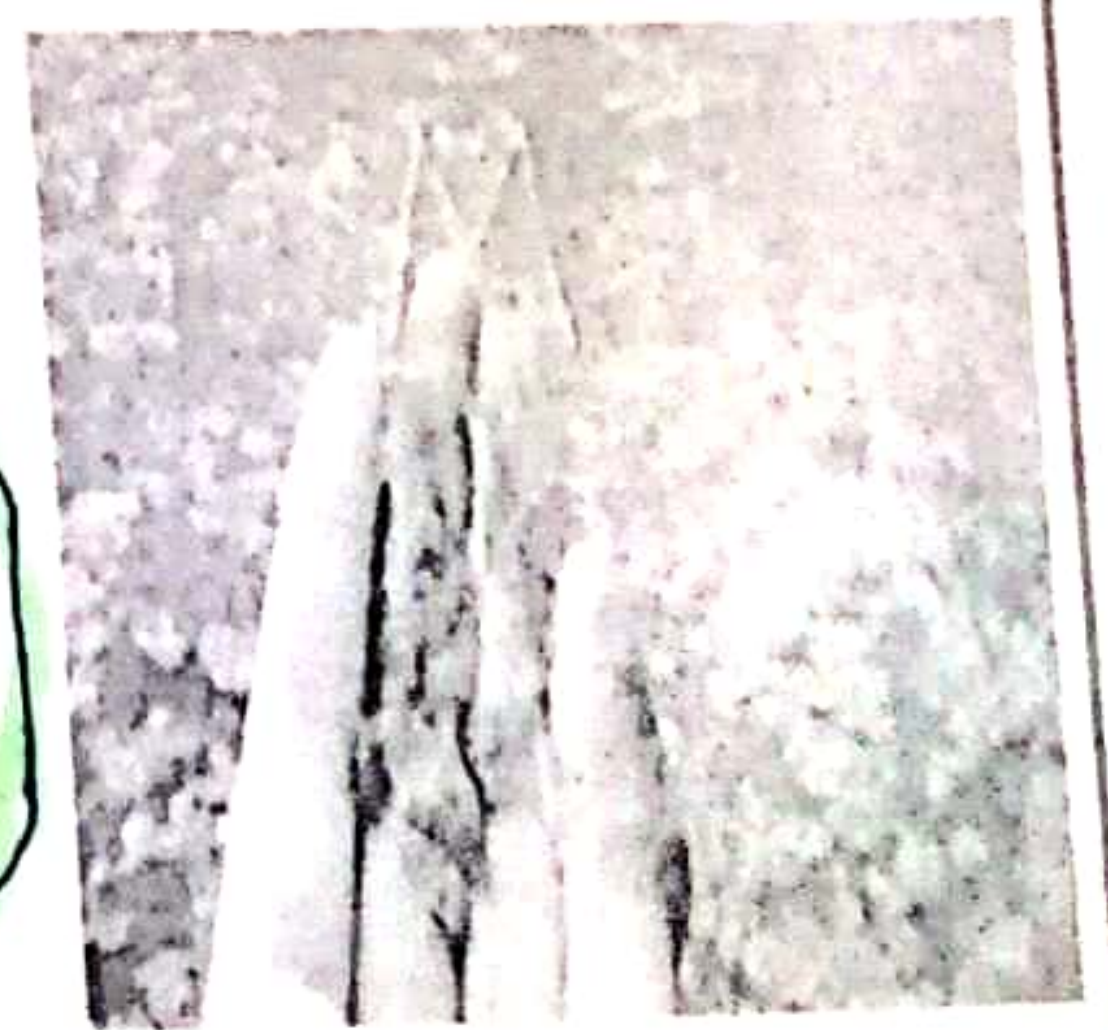
طخالب تنوع الحياه : Filamentous algae IS : الرافدة

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:

- 1) - Isolation
- 2) - Sterilization
- 3) - Culture in artificial media

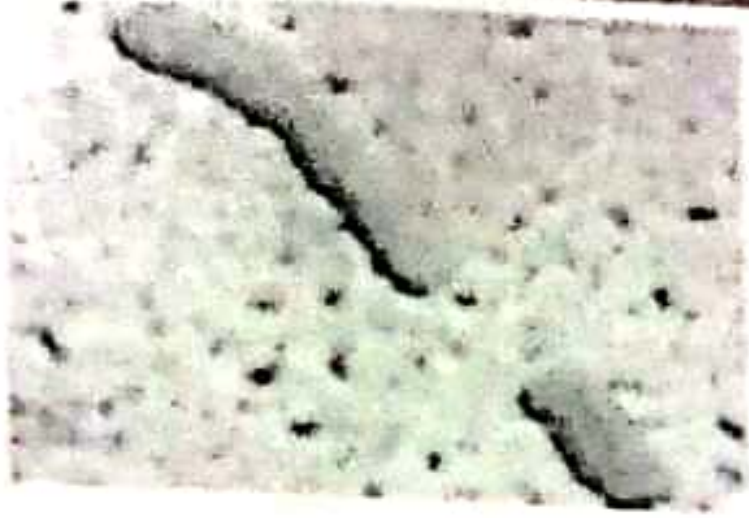


شو لازم نعمل
لدرست ال
microorganism

تقسيم
طخالب
خيطية

Important Note!

* Not all microorganisms are harmful



Microbes help us by

Useful
micro-
organism

- decomposing organic waste } علاج المياه العادمة لتصبح حالة للاستخدام
- performing photosynthesis
- producing ethanol, acetone, vinegar, cheese, (bread) ... Producing food
- producing insulin and many other drugs } Such as:- 1) insulin 2) Penicillin (الكثيرا النافعة في الاضداد)
- Normal flora that is found in intestine } Prevent our body from harmful microorganism

Microbes harm us by

Harmful
micro-
organism

- causing disease
- causing food spoilage

تلف الغذاء

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.

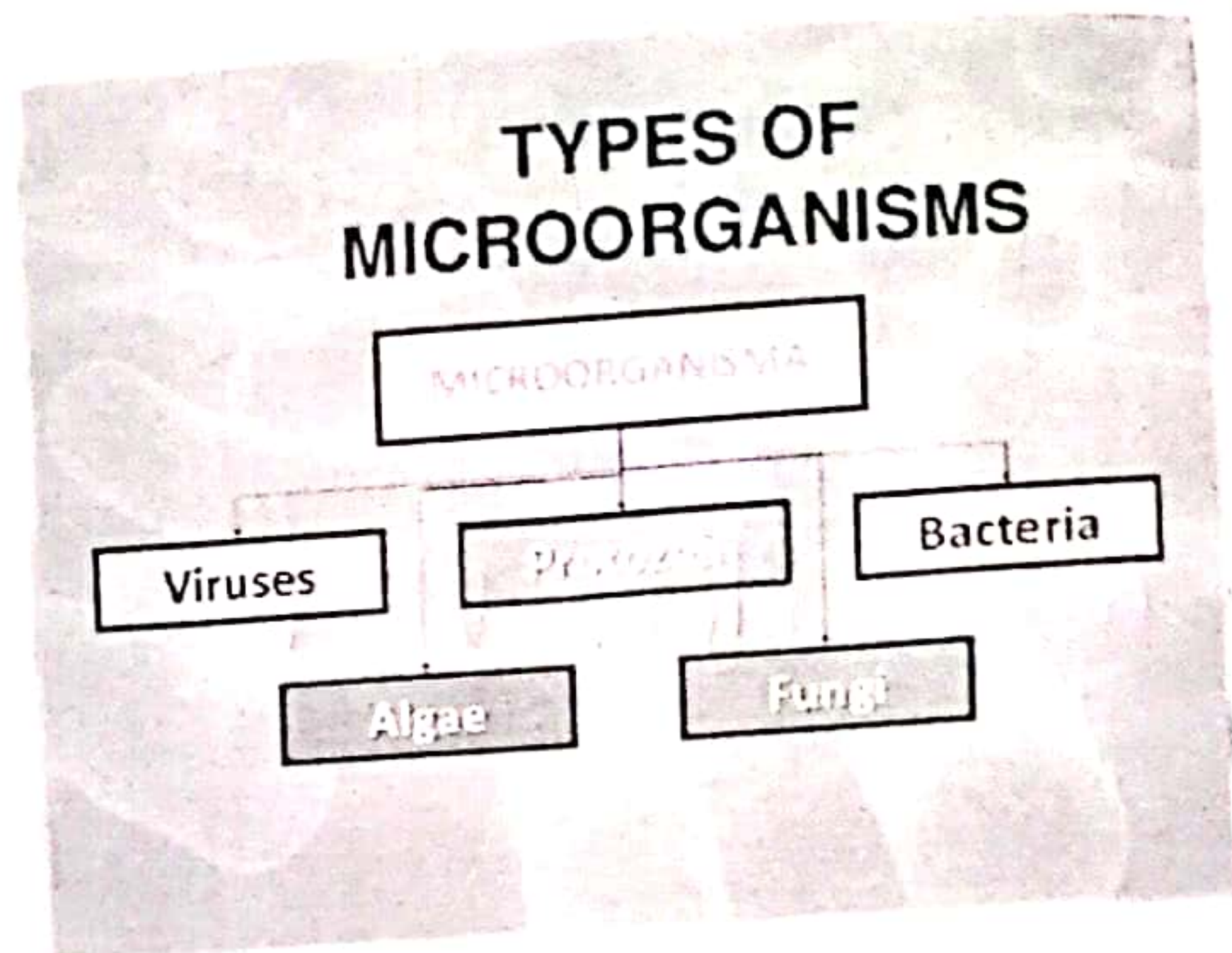
صناعي
• Industrial uses of microbes.

→ synthesis food & Alcohol

Types of microorganisms

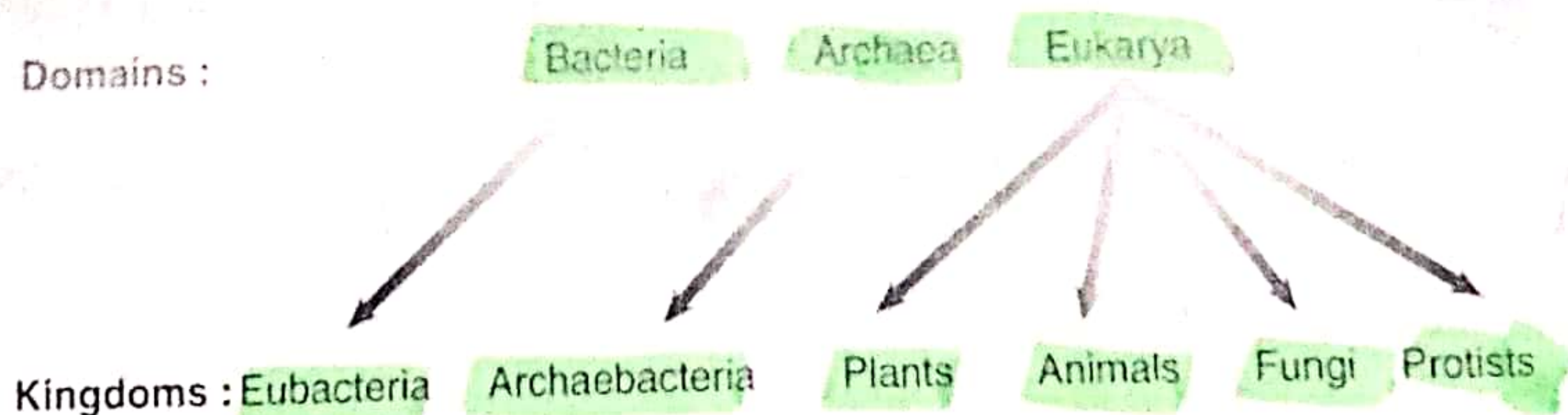
They are :

- 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

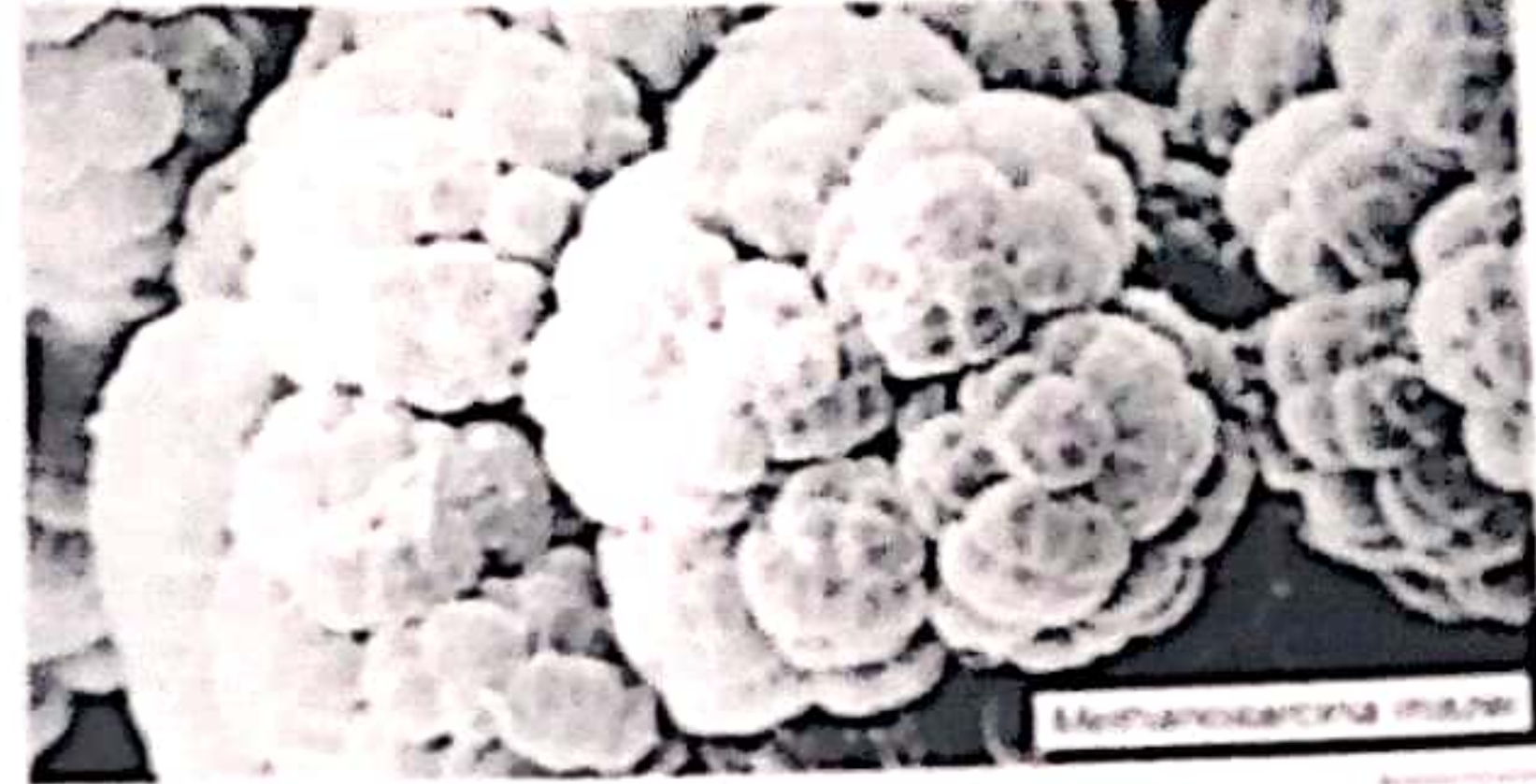
Relationship Between Three-Domain and Six-Kingdom Systems of Classifications



Domains

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

DOMAIN ARCHAEA



a. Archaea are capable of living in extreme environments.

1.5 μm

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 BACTERIA



b. Bacteria are found nearly everywhere

1.5 μm

Domain Eukarya

3. Eukarya – ¹⁾ unicellular to multicellular, ²⁾ complex and ³⁾ organized cells with nuclei and organelles (mitochondria)

Eukarya are further ⁴⁾ categorized into one of four Kingdoms.
(know these kingdoms)

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Kingdoms that have nucleus:-

1) Protists

2) Fungi

3) Animals

4) Plants

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
	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

Eukaryotes are divided into four kingdoms

Microbiology

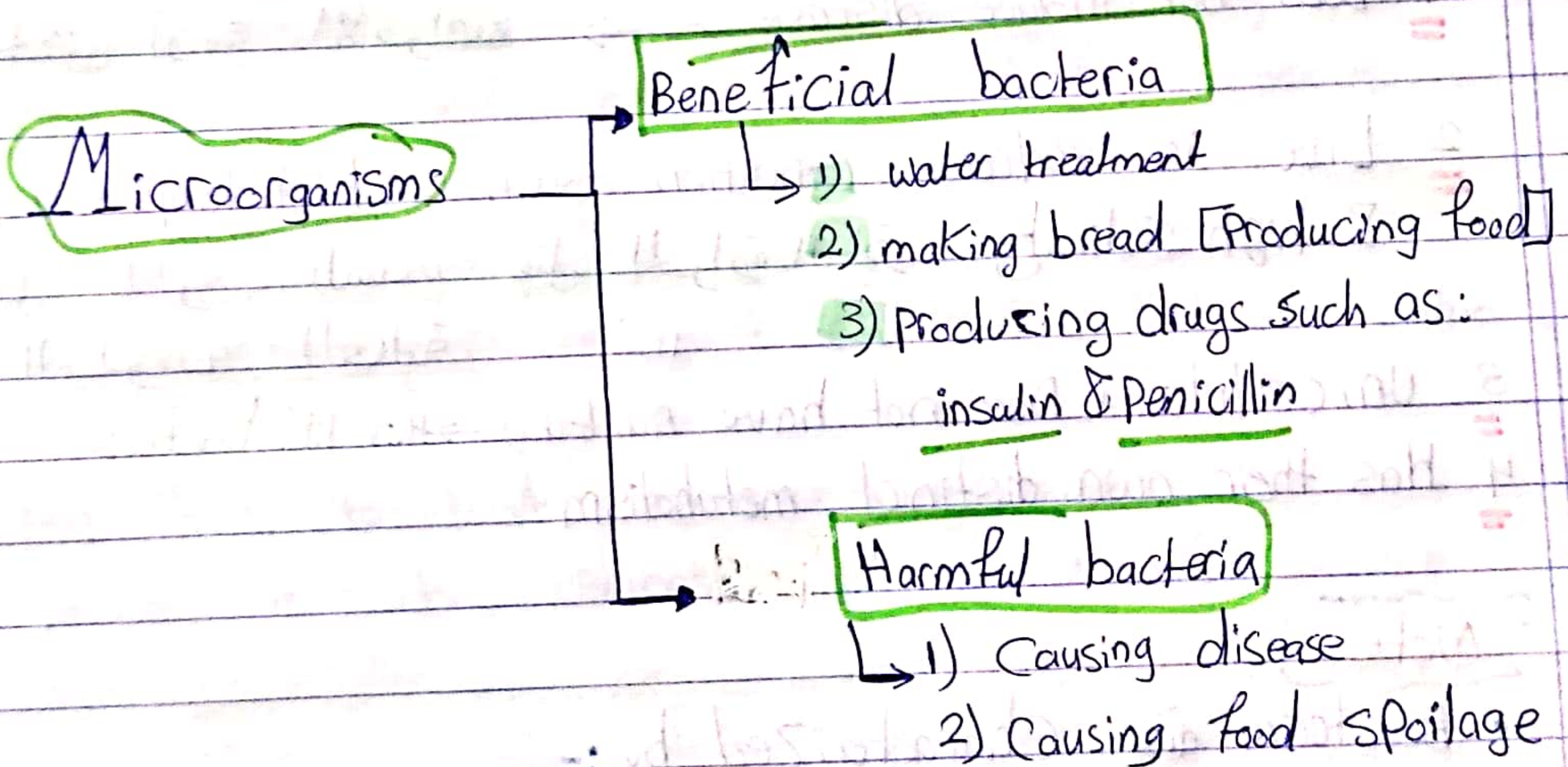
* Summary of some points in previous slides & some explanation :-

① لما نعطى المريض Treatment وما يستجيب يكون سبب ال Resistance هذا أسباب ال Resistance هي

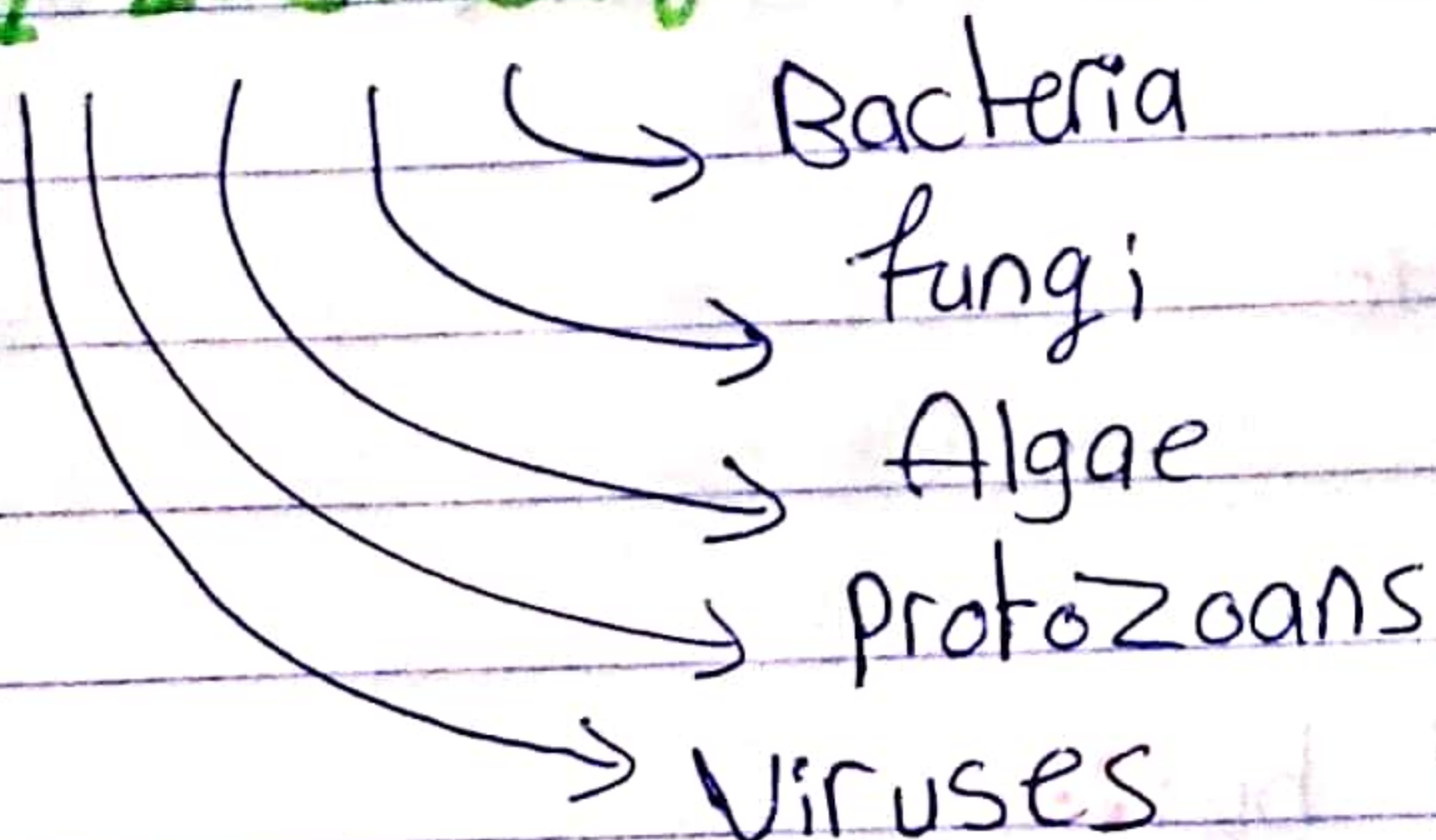
Ⓐ نعطى المريض Antibody قلنا لنعالج ركتريا عنده ولم يعمل العلاج ← Incomplete drug

Ⓑ ممكن اختيار الدواء خاطئ أو اختيار الجرعات يكون خاطئ ← wrong drug

Ⓒ تأثر دواء آخر تناولته المريض مع استجابة دواء آخر فلا تظهر استجابة ← Another drug affect on drug responding



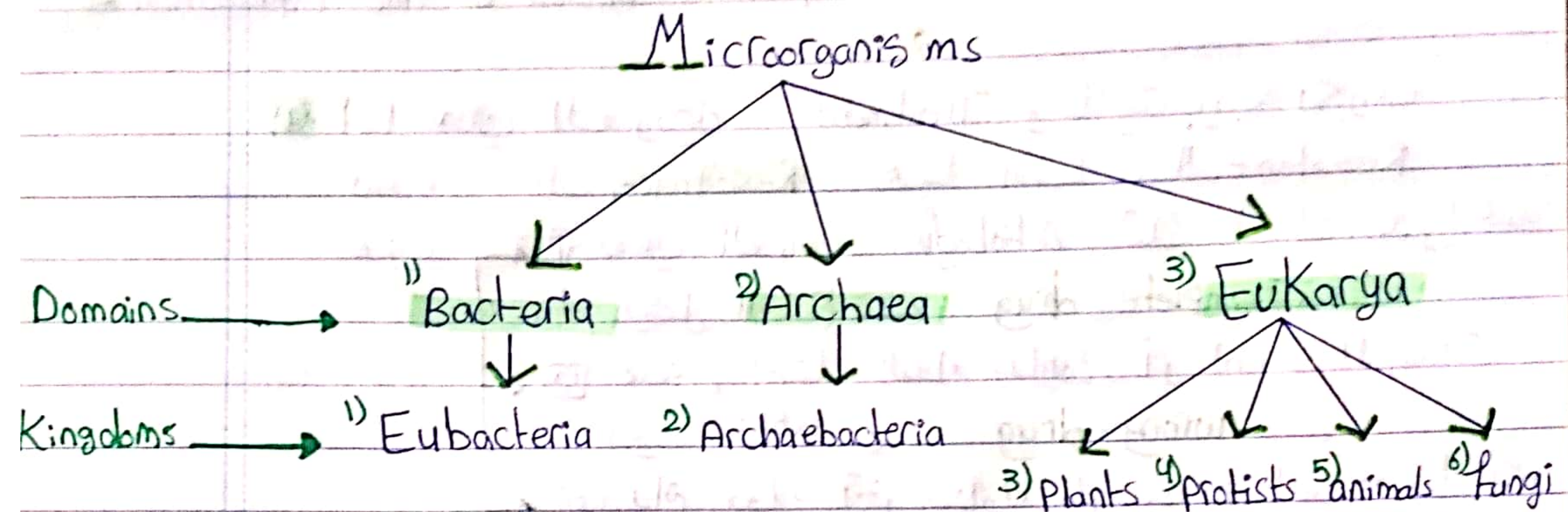
Microorganisms



note

الفيروسات تختلف عن الباقين لأنه لا يستطيع العيش على الأسطح لوحده فهو يحتاج إلى Host cell

* Classification of microorganism (3 domains & 6 Kingdoms)



Note :-

- Archaea is characterized by :-

1 Does not induce disease → لا تحفز أو تسبب الأمراض

2 Live in extreme condition such as:- high temperature

& high salinity → تتحمل الظروف الشديدة مثل الحرارة العالية و الملوحة العالية

3 Unicellular (Does not have nucleus) → this lik bacteria

4 Has their own distinct metabolism

Note

- Bacteria are characterized by :-

1 Single-celled organism that lack a membrane-bound nucleus

2 Are found almost everywhere

Note

- Eukarya is characterized by :-

1 Related to any Kingdoms that have nucleus

↓ التواريخ ليست للحفظ

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.

Single lense microscope

أول من اكتشف الكائنات الدقيقة باستخدام

□ **Louis Pasteur (1822–1895)**: Pasteur developed a process (today known as ^{البسترة}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.

بأسه
ترتبط عملية
البسترة

ربط بهليات التعقيم أول التي هي البسترة

• وجد إنه أي Liquids نستطيع قتل الكائنات الدقيقة
التي فيها عن طريق السخني إما

→ (63 - 65 °C) for 30 minutes

→ (73 - 75 °C) for 15 seconds

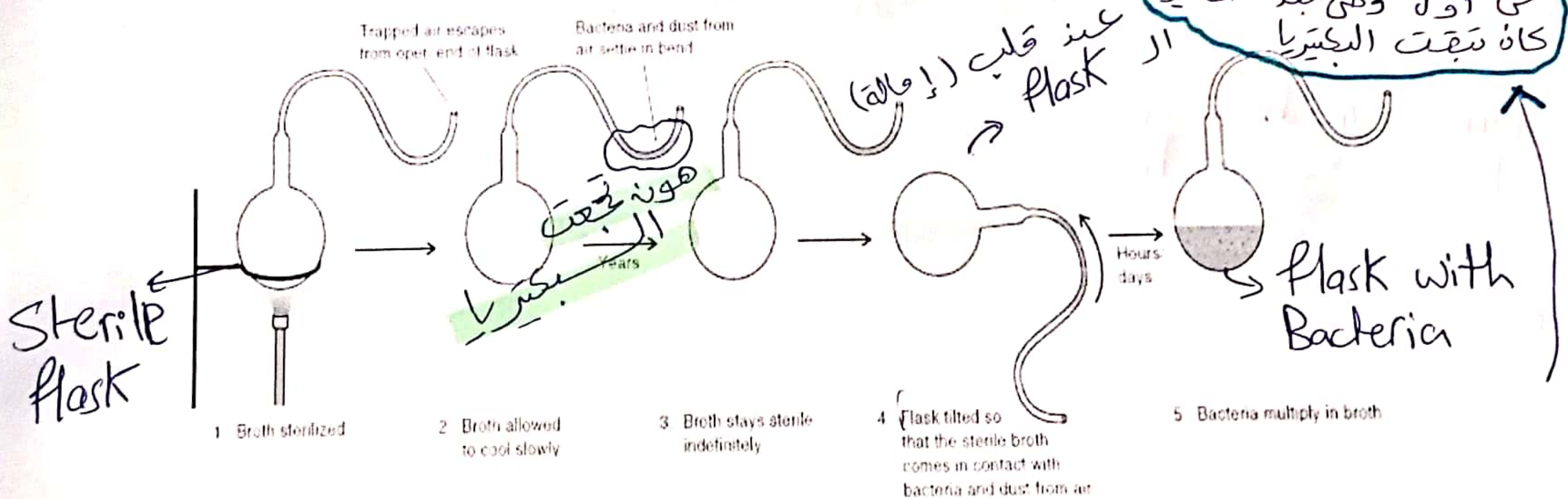
→ Father of microbiology **LOUIS PASTEUR (1822 - 1895)**



- Disproved spontaneous generation of microbes by preventing "dust particles" from reaching the sterile broth
- In 1861, completed experiments that lay to rest spontaneous generation. 3) He says that by boil we kill bacteria
- Showed microbes caused fermentation and spoilage 2)
- Considered by many as "Father of Microbiology"

لأنه هو رفض نظرية داروين التي قالت كل شيء ينشأ من العدم

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.

- لو صنع تجربة Louis Pasteur ← أخذ Swan necked flask وكان في Broth تعتبر media سليمة بال nutrients للمicroorganism ف سؤ راع عمل 1) سخن ال Flask وهو ب Standing Position فتم قتل الكائنات الرقيقة وحصل ال سيجر 2) تركها مفت opening من ال Flask فستيج' لا microbs multiply و contamination 3) Cool slowly ← broth steril

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.

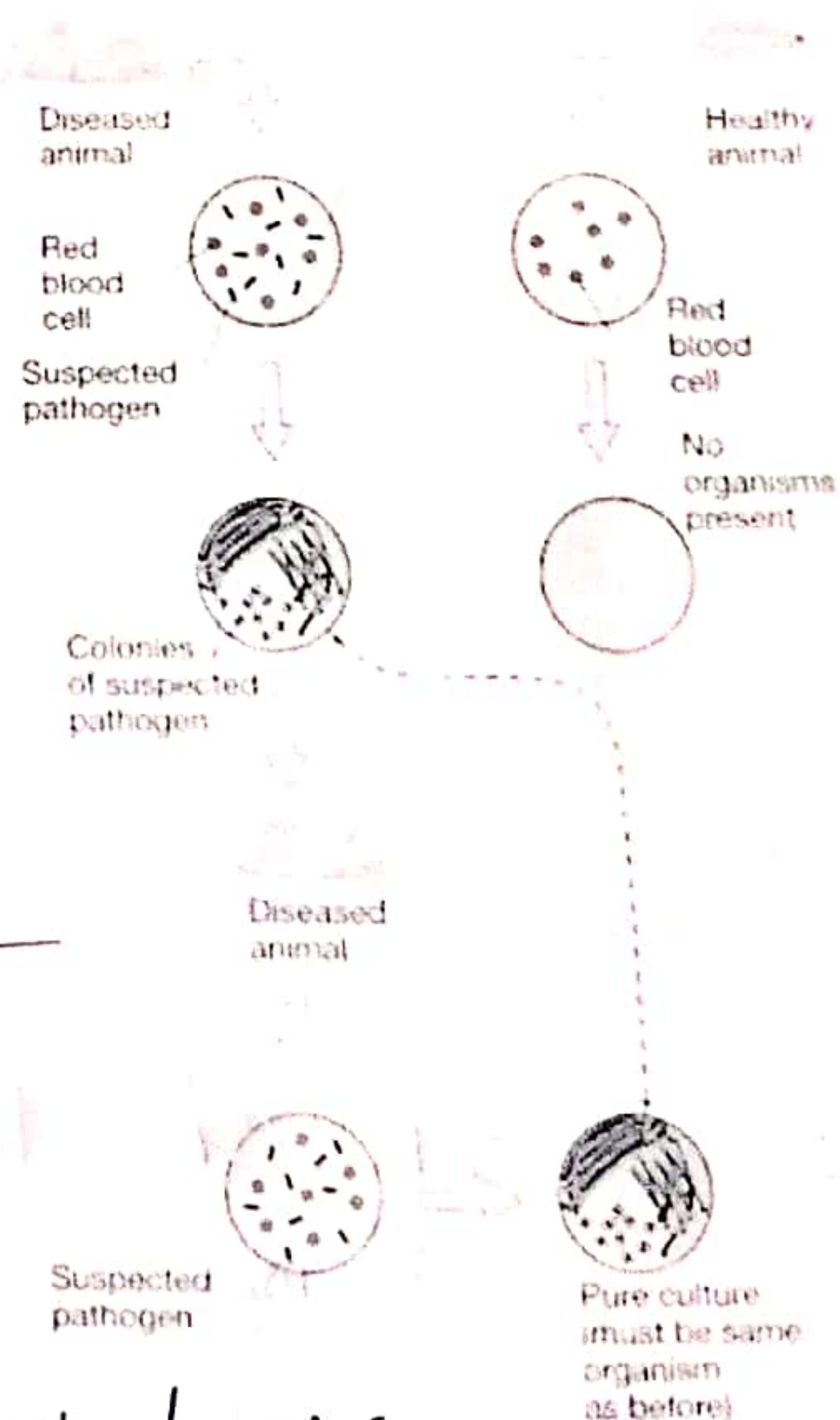
- His criteria (is still used) to establish the link between a microorganism and a particular disease that it cause, is known as Koch's postulates.

كان لروبرت نظرية انه هناك علاقة بين ال Disease و microorganism قال Infected Patient اكد يكون عامل للمرض

Koch's Postulates

once we have a disease So we have a causative factor

- 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.



نظريه Robert ← أخذ Diseased animal cell وعملها Isolation & culturing ووجد فيها ال microorganism ولا رزغ هي ال cell بحيوان سليم أصابة المرض

History of Microbiology – Aseptic Technique- Joseph Lister

- 1) • He is popularly known as "Father of antiseptic surgery".
- 2) • He was deeply interested in the prevention of postoperative sepsis.
- 3) • 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.



لـ ارتباط دور هذا العالم بالعلماء المعقمة
واعتمد على نظرية Louis Pasteur

Penicillin ← ALEXANDER FLEMING ← الكشف الـ

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.

كان عنه Petri dish وفيه بكتيريا ولما رجع وجد البكتيريا
متة وكان فيها نوع من الفطريات وبسببها ماتت البكتيريا

Flemming and Penicillium



Naming and Classifying microorganisms

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

Bacteria name

Genus - specific epithet (species)
capital letter small letter

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

* why *E. coli* was named as that?

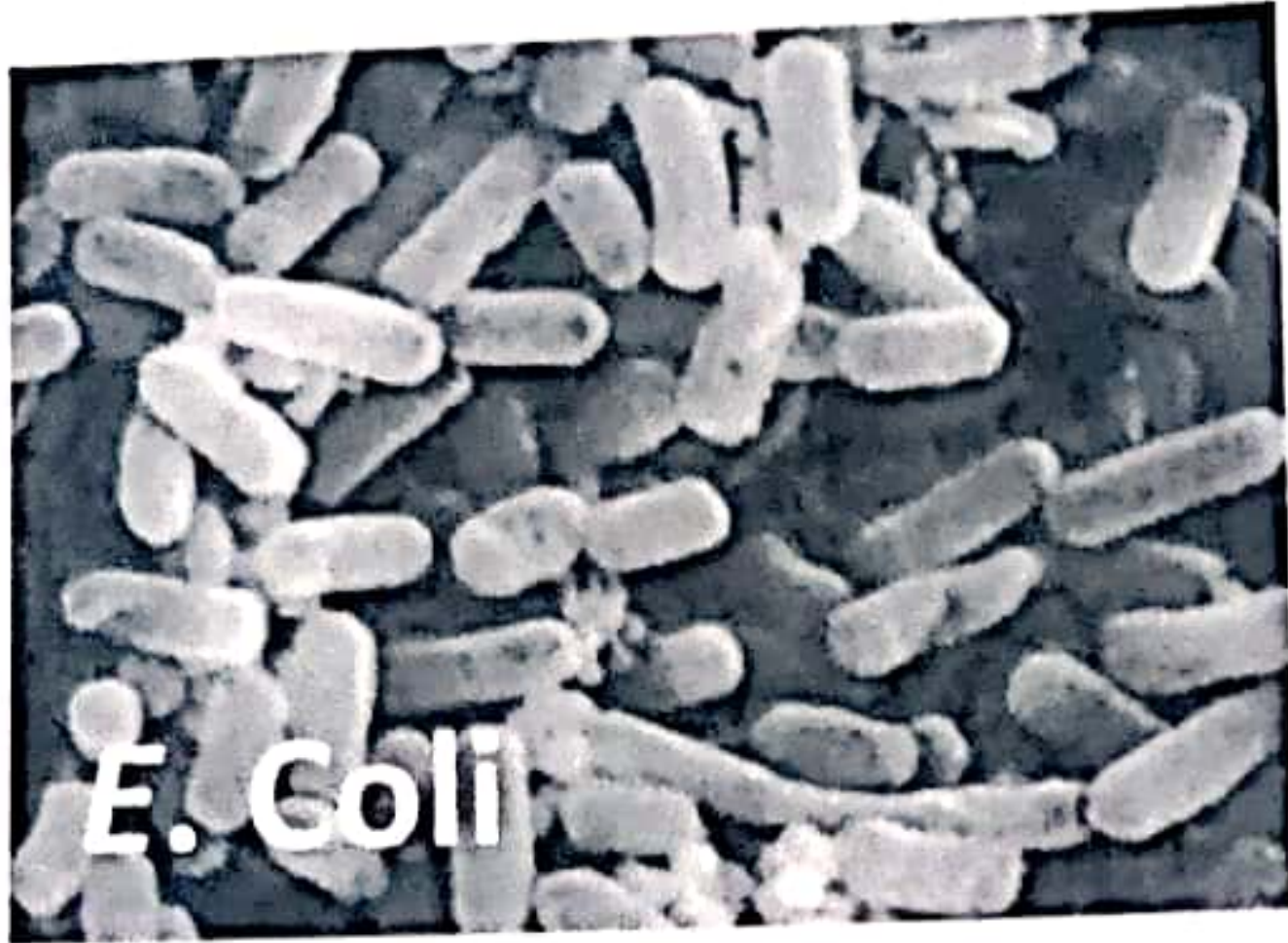
↳ because *Coli* to *colon*
(*E*) to the discover (Theodor *Escherichia*)
Escherichia

Scientific Names

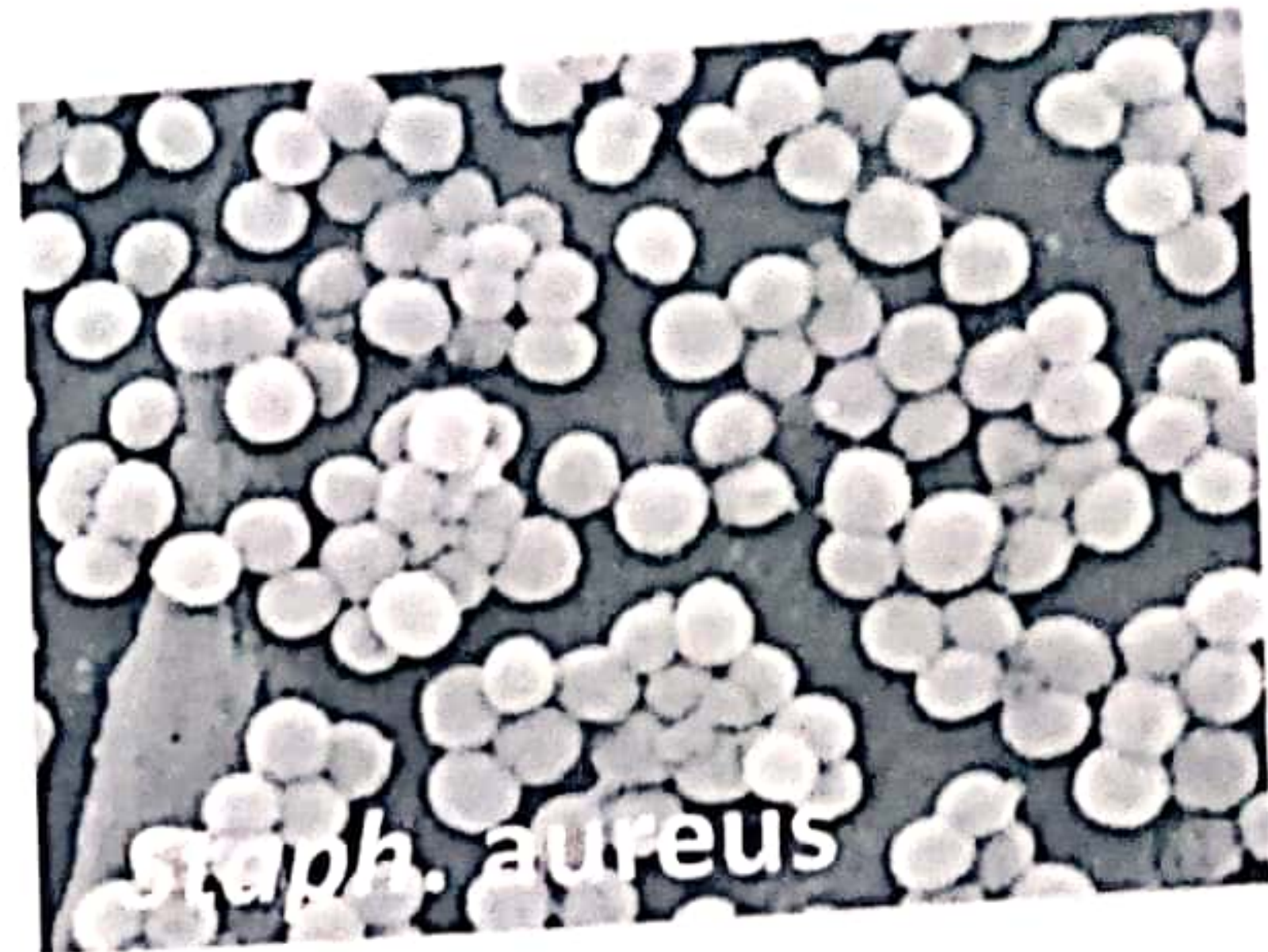
Scientific Binomial	Source of Genus Name	Source of Specific Epithet
1) <i>Klebsiella pneumoniae</i>	Honors Edwin Klebs (العالم)	The disease
2) <i>Streptococcus pyogenes</i>	Chains of cells (strepto-)	Forms pus (pyo-)
3) <i>Penicillium chrysogenum</i>	Tuftlike (penicill-) مثل الوردة	Produces a yellow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

الاسم ممكن يجي من الشكل أو طريقة الترتيب

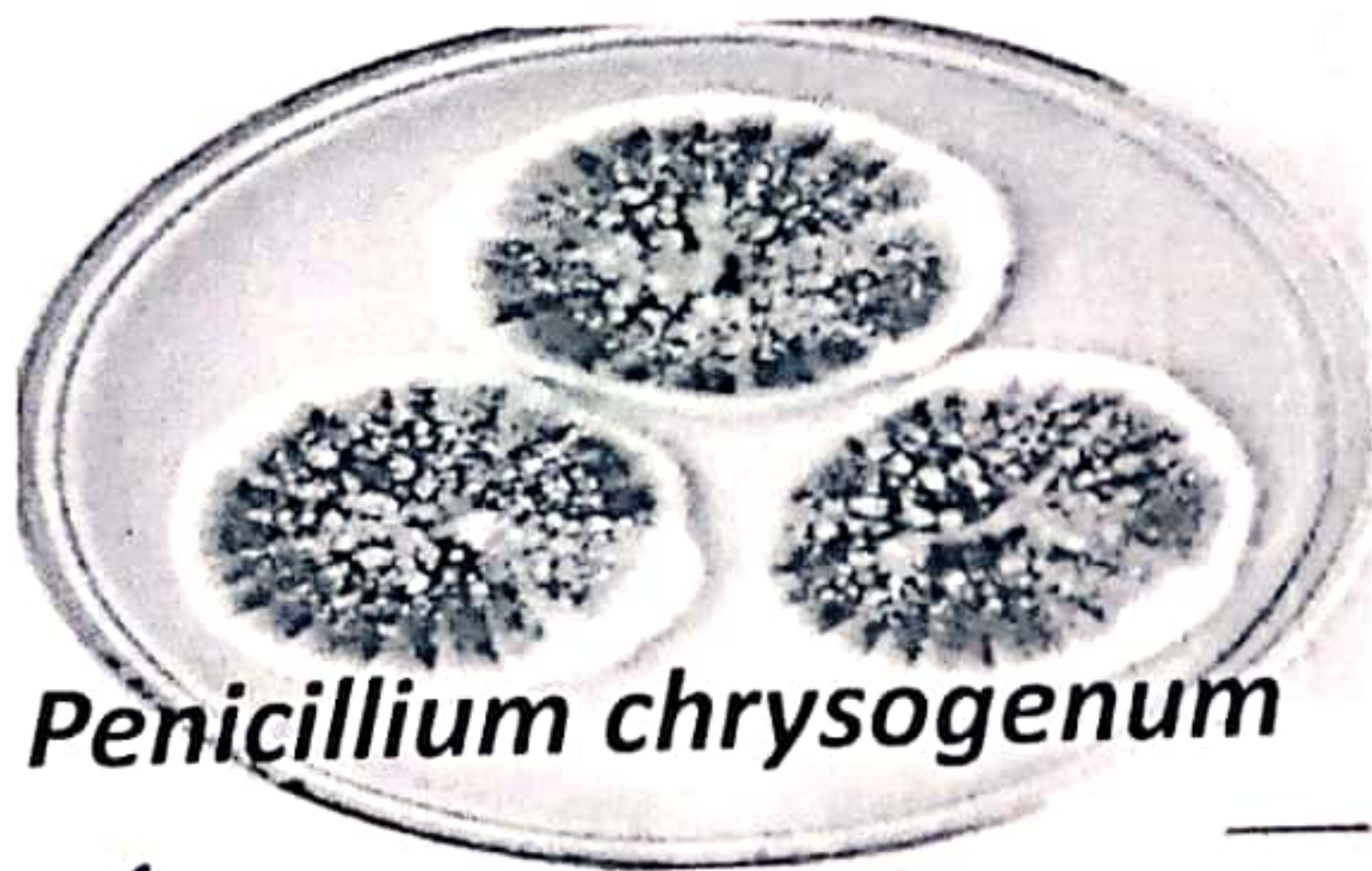
Scientific Names



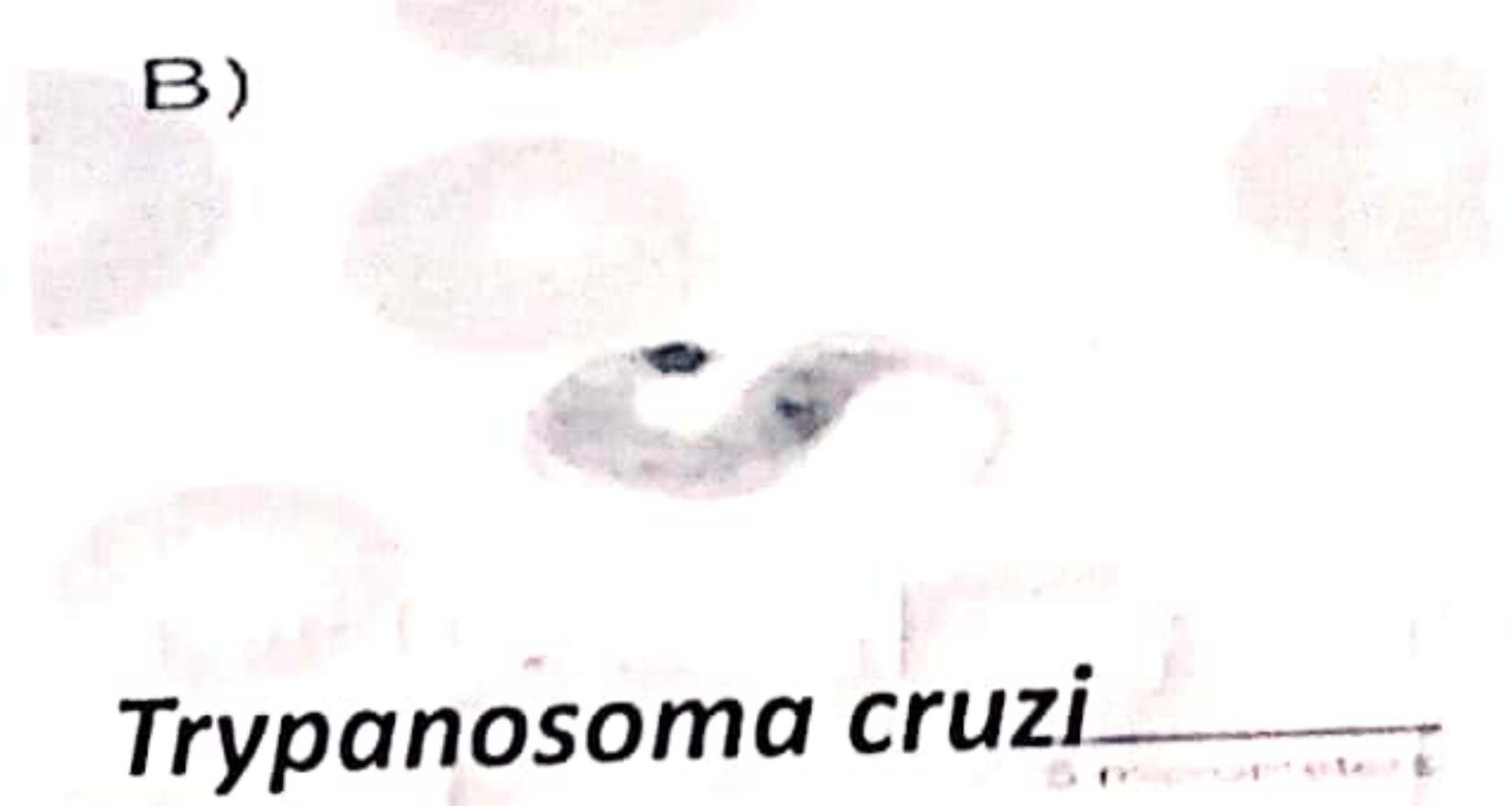
E. Coli



staph. aureus



Penicillium chrysogenum



Trypanosoma cruzi

شكلا
ري الورد

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.

Sourced disease (the disease)

Scientific Names

Genera named after Microbe's shape:

Vibrio cholerae: بكتيريا شبيهة بالدمعة

Bacteria is comma shaped which causes cholera

Staphylococcus epidermidis:

Staphylo means clusters; coccus means spheres.

Genera named after Attribute of the Microbe:

(Action of microbe) بكتيريا تحول السكر إلى كحول

Saccharomyces cerevisiae:

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

البكتيريا المسؤولة عن تحويل السكر إلى كحول

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).

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

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

$$1 \text{ Mm} = 10^{-6} \text{ m}$$

$$1 \text{ Mm} = 10^{-3} \text{ mm}$$

$$1 \text{ mm} = 10^6 \text{ nm}$$

$$1 \text{ mm} = 10^3 \text{ Mm}$$

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 $10 - 100 \mu\text{m}$

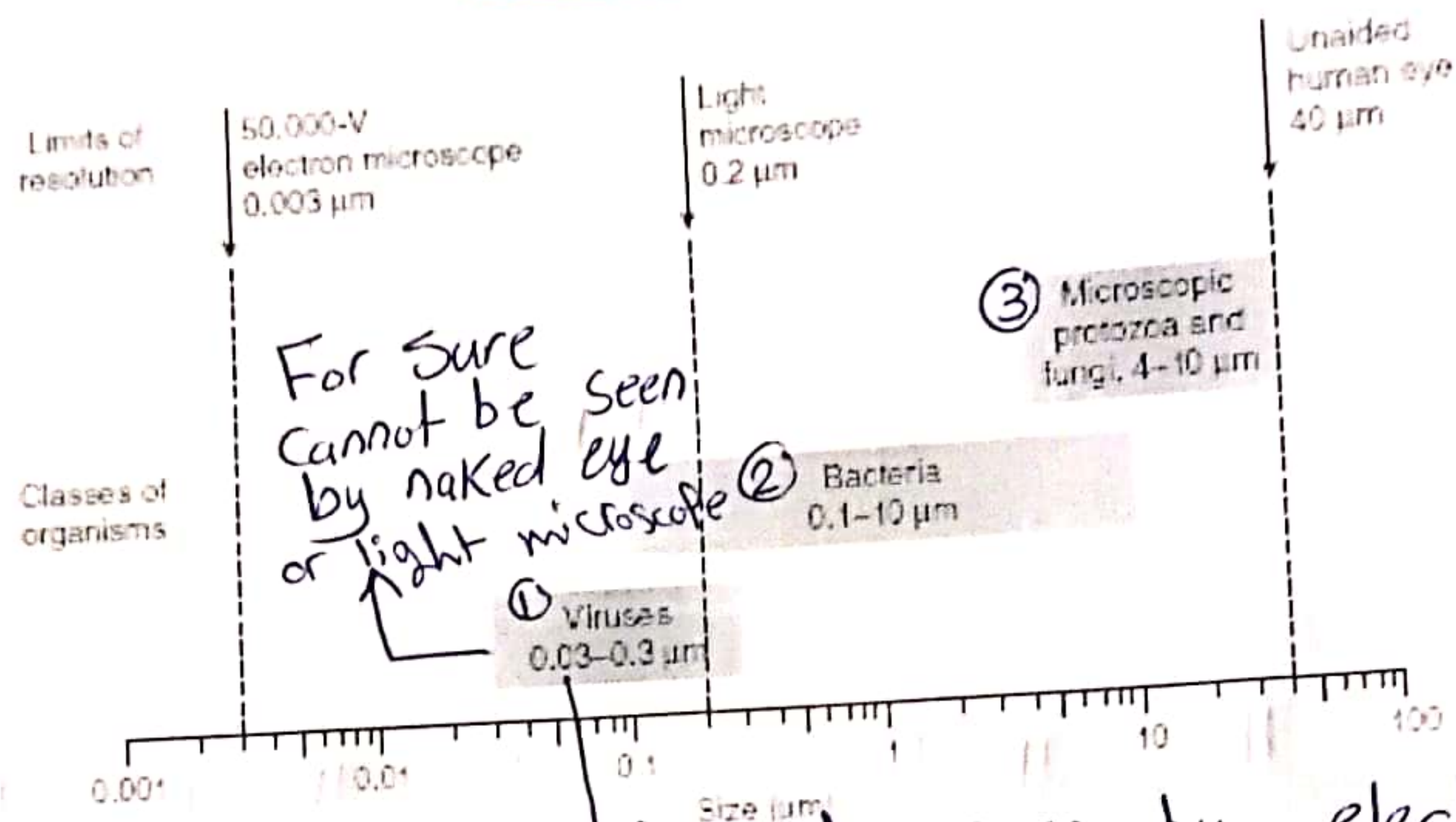
— Human $\rightarrow 100 \text{ Mm}$

— RBC's $\rightarrow 8 \text{ Mm}$

— Animal cells $\rightarrow 10 - 100 \text{ Mm}$

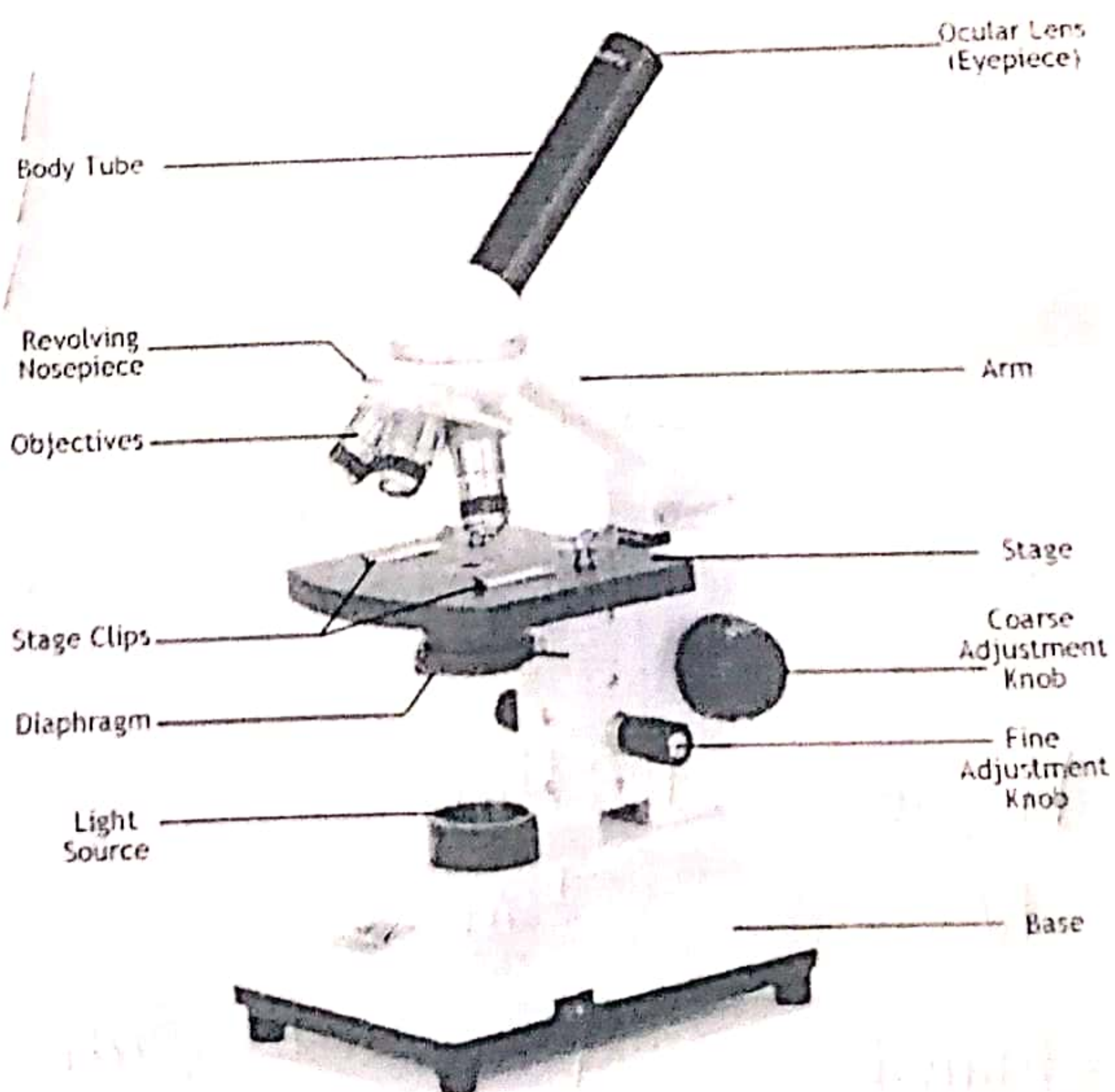
Relative size of microorganisms.

الاعتماد هنا على



* Sizes of viruses mostly smaller than bacteria

Microscope



الاعتماد
على

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.

→ more specific & more details we can see
(greater than SEM)

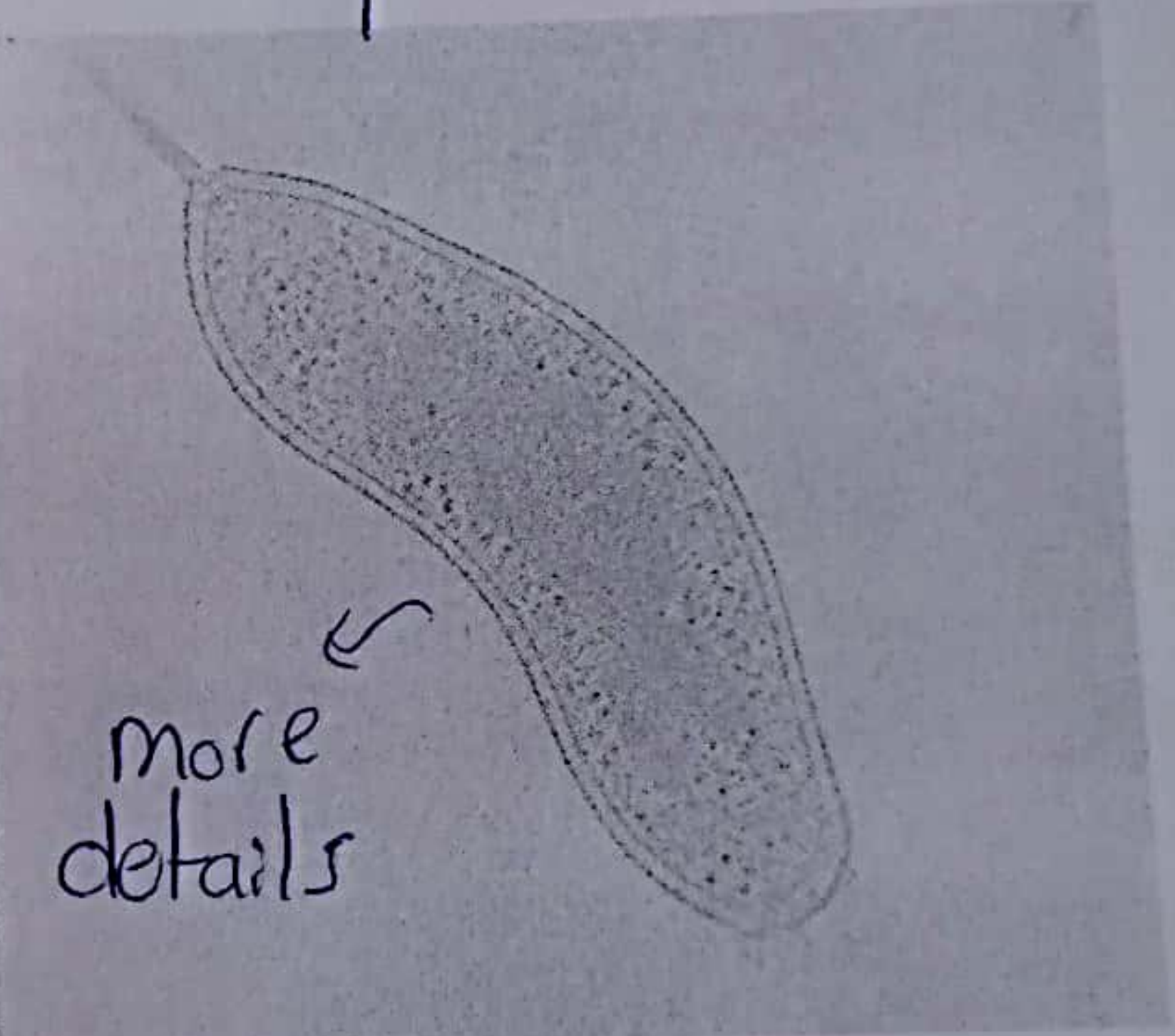
High
Resolution

by SEM

by TEM



more details



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

History of microbiology

Microbiologists

Anton van Leeuwenhoek Louis Pasteur Robert Koch Joseph Lister Alexander Fleming

1 Anton van Leeuwenhoek :-

- First microbiologist observe bacteria by using single lens microscope.

2 Louis Pasteur :-

- He developed pasteurization process
↳ why?? To Kill microbes by heating
ether on $\begin{cases} (63-65^{\circ}\text{C}) \text{ for } 30 \text{ minutes} \\ (73-75^{\circ}\text{C}) \text{ for } 15 \text{ seconds} \end{cases}$
- Disproved spontaneous generation of microbes
↳ How?? by preventing "dust particles" from reaching the sterile broth
- He lays to rest spontaneous generation
- Showed microbes causes $\rightarrow$ ① Fermentation ② Spoilage

He is the Father of Microbiology

Steps of Louis's experiment :-

- ① Heating Swan-necked flask that contain broth at standing position

Broth → rich in nutrient for microorganisms

- ② Broth allowed to cool slowly (Broth here still sterile)

- ③ Flask tilted so that the sterile broth comes in contact with bacteria & dust from air

لوضح هذه النقطة ← تم إمالة الـ Flask 6 فخلت الـ microorganism

المكونة في فتحة الـ Flask عندما تم تبريده (Cooling) فأصبح الوسط

فعل بال microorganism في multiply bacteria و Contamination

3 Robert Koch :-

- He worked in cholera, anthrax & tuberculosis

- He was awarded a Nobel prize

- He set out criteria to test to establish the link between 'microorganism' & particular disease that it cause.

(Demonstration that microorganisms cause disease: Germ theory)

4 Joseph Lister :-

- He is known as "Father of antiseptic surgery"

- He was attracted by Pasteur's germ theory of disease & conclude that sepsis or wound infection may be due to microbial growth derived from atmosphere

5 Alexander Fleming :-

- He discovered mold was identified as (Penicillium notatum)

Scientific names

→ Genera named after individuals :-

① Escherichia coli

related to: Discover

Disease in colon

② Neisseria gonorrhoea

related to discover

related to gonorrhoea disease

→ Genera named after Microbe Shaped :-

① Vibrio cholerae

related to

→ comma shaped cholera disease

② Staphylococcus epidermidis

→ clusters spheres

→ Genera named after Attribute of microbe :-

① Saccharomyces cerevisiae

(sugar fungus beer

→ it is yeast which convert sugar in the sample into alcohol