SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES

Coimbatore -641035

COURSE NAME : PHARMACEUTICAL MICROBIOLOGY - BP303 T

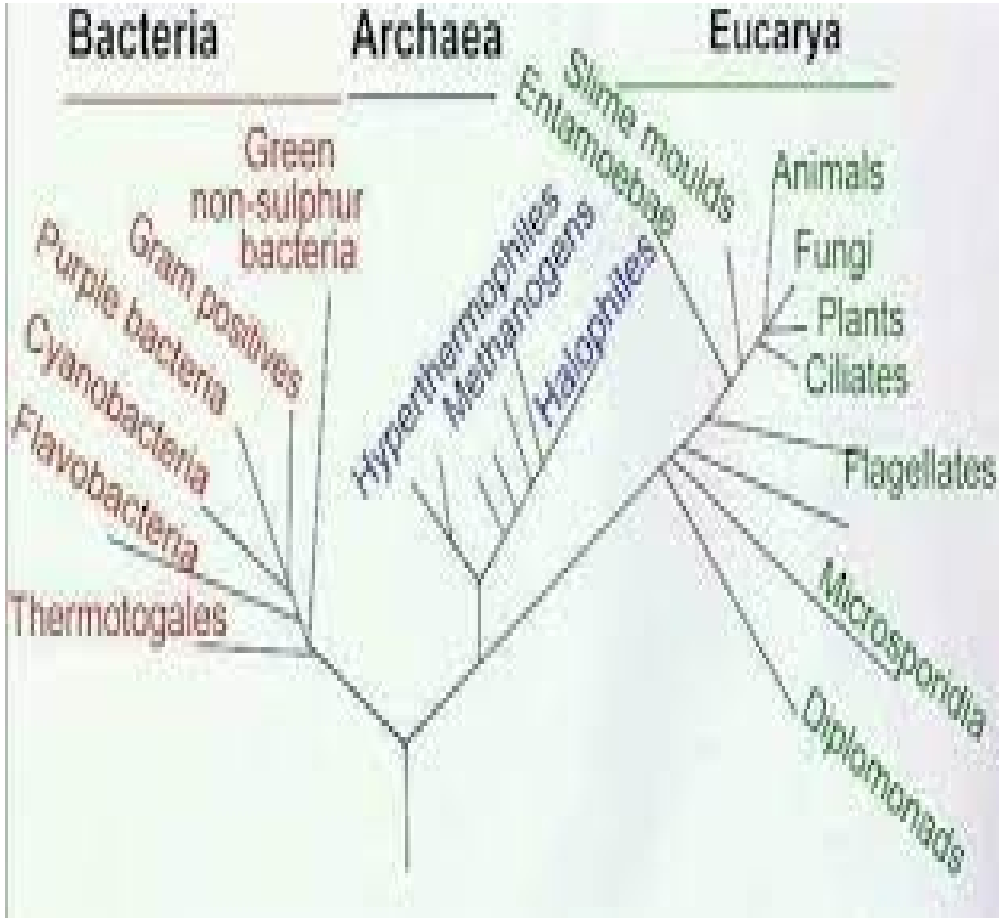
II YEAR / III SEM

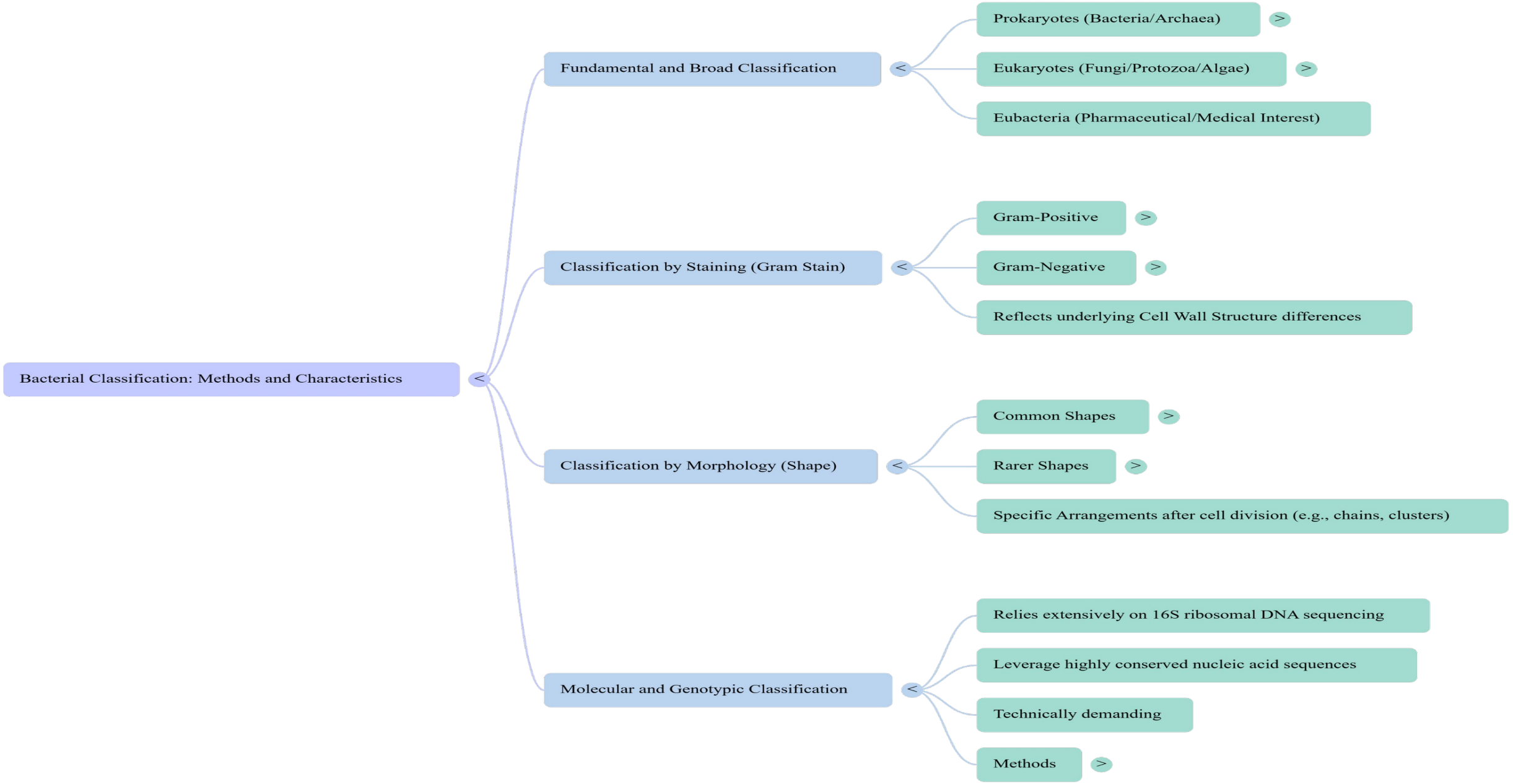
UNIT 1

SUB TOPIC : HISTORY AND SCOPE OF MICROBIOLOGY

Content

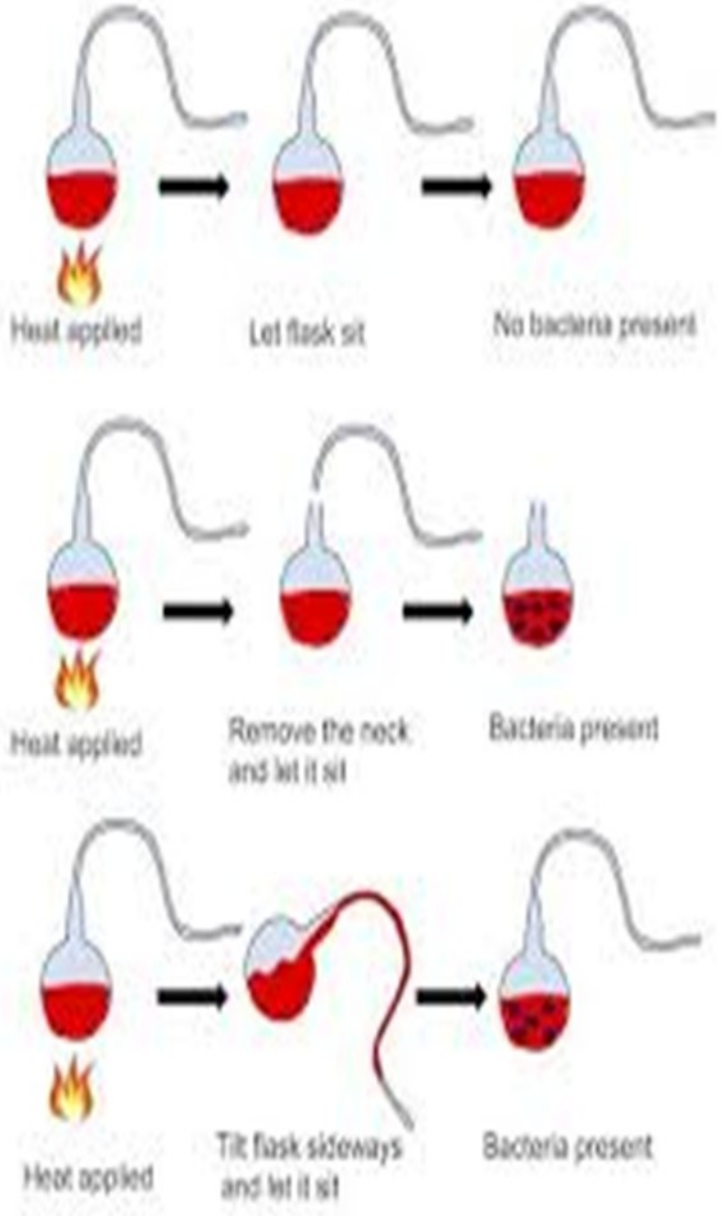
- Introduction of microbiology•
- Branches of microbiology
- Scope and importance of microbiology



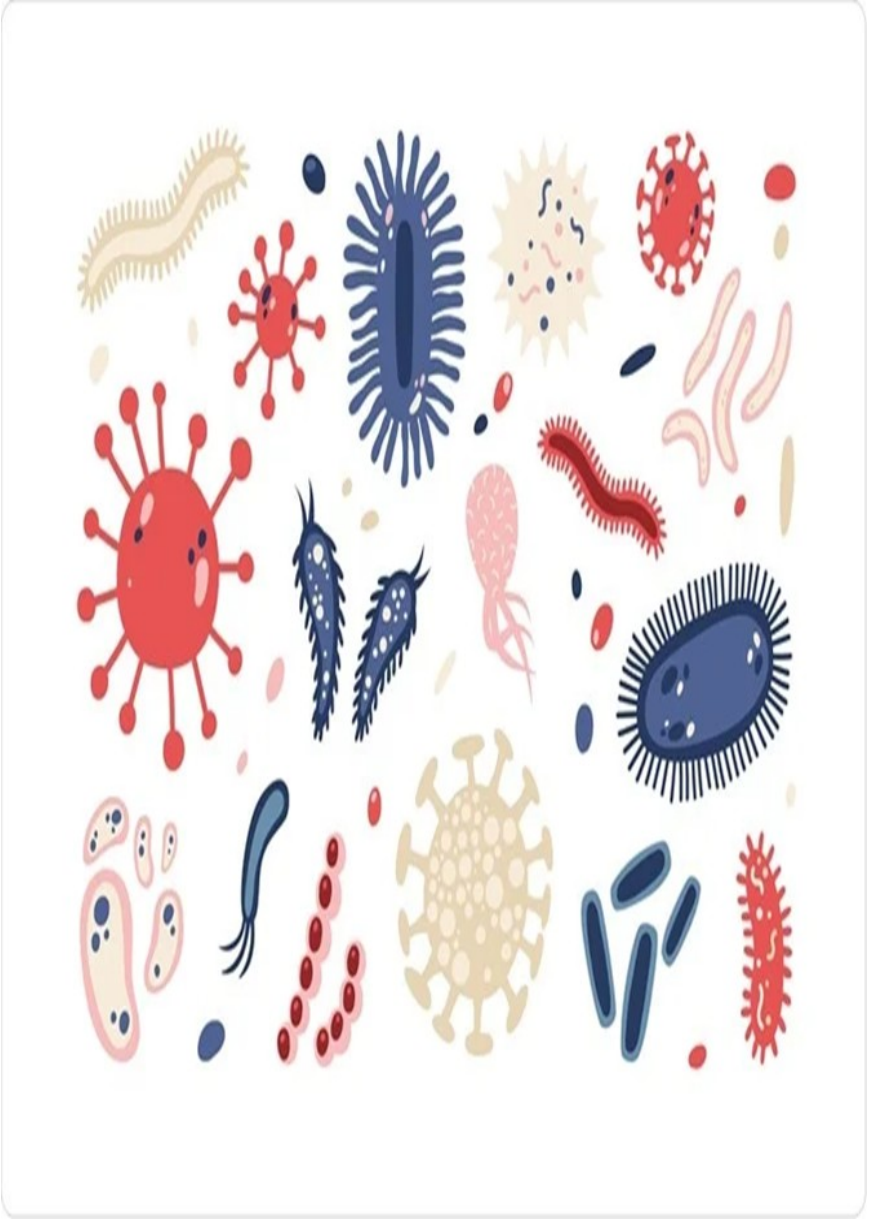

Bacterial Classification: Methods and Characteristics
Fundamental and Broad Classification
Prokaryotes (Bacteria/Archaea)
Eukaryotes (Fungi/Protozoa/Algae)
Eubacteria (Pharmaceutical/Medical Interest)
Classification by Staining (Gram Stain)
Gram-Positive
Gram-Negative
Reflects underlying Cell Wall Structure differences
Classification by Morphology (Shape)
Common Shapes
Rarer Shapes
Specific Arrangements after cell division (e.g., chains, clusters)
Molecular and Genotypic Classification
Relies extensively on 16S ribosomal DNA sequencing
Leverage highly conserved nucleic acid sequences
Technically demanding
Methods

Introduction

- Microbiology- ► Micro- Small living organisms ► Bios- life ► Logos- Study
- Microbiology is a branch of biology that deals with the study of micro-organisms which are usually invisible to naked eye.
- Micro-organisms/microbe- organisms with a diameter upto 0.1 mm or less than 0.1 mm are designed as micro-organisms/microbe.
- The term microbiology was introduced by Louis Pasteur



At present 6 major groups are included under microorganisms
i.e bacteria, fungi, viruses, protozoa, algae and parasites.
Therefore they are studied under the following branches of microbiology:
Bacteriology | Study of bacteria
Mycology | Study of fungi
Virology | Study of viruses
Protozoology | Study of protozoans
Phycology | Study of algae
Parasitology | Study of parasites |



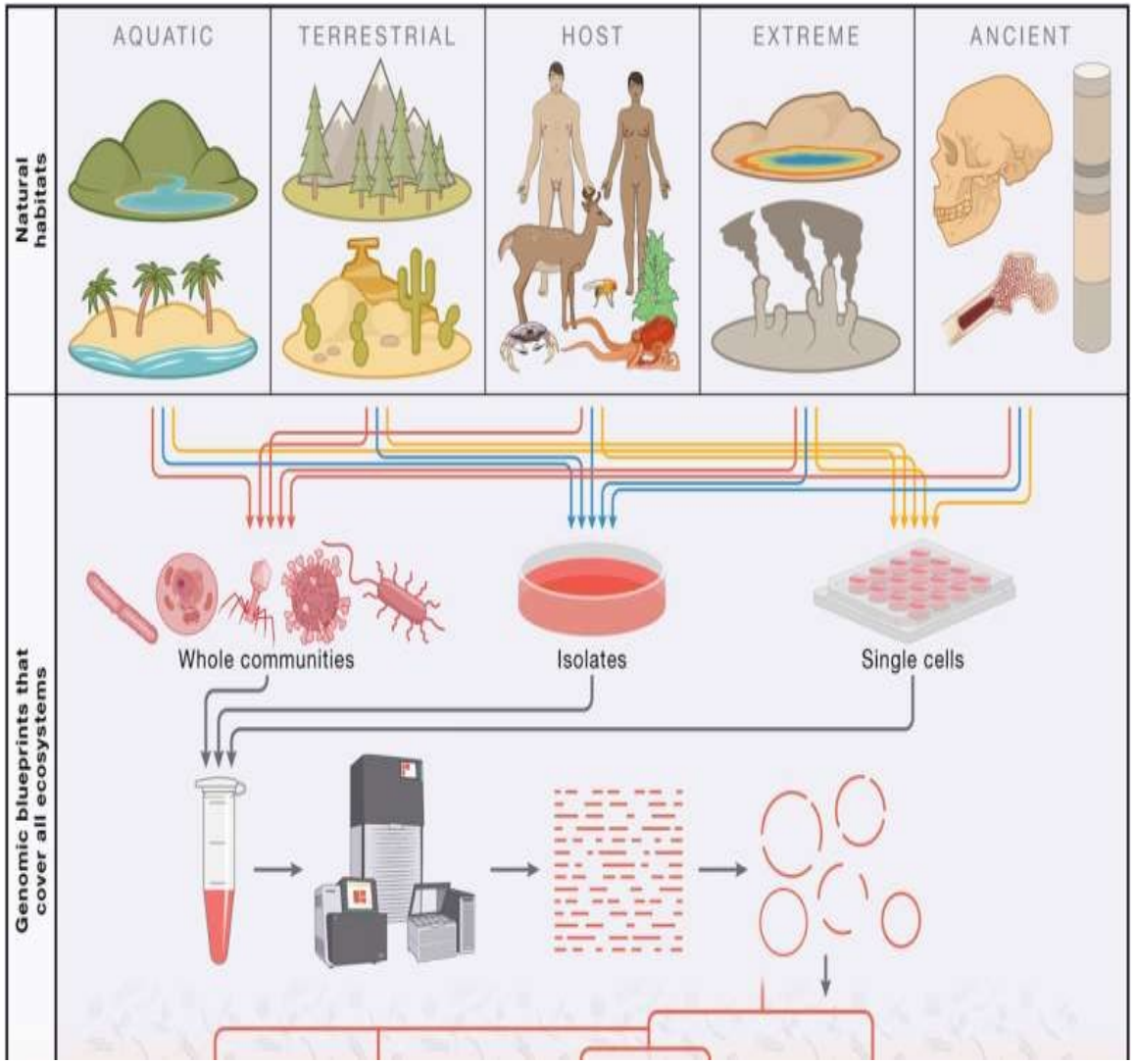
History

• History of microbiology is divided into 3 stages:

1) Discovery stage

2) Transition stage

3) Modern microbiology



Discovery stage

Aristotle- describe living and non living organisms and their differentiation □ Roger Bacon (13th century)- describe that disease caused by living organisms □ Fracastorius (1546)- describe that communicable diseases caused by living agents known as germs □ Robert Hooke (1665)- first report on cell structure □ Antony van Leeuwenhoek (1632-1723)- was first person who used a microscope of his own design for to observe microbes ► He discovered in 1675 and named bacteria and protozoa as animalcules ► He has provided full description of bacteria that's why he was known as founders of microbiology

2) Transition stage:

• Francesco Redi (1626-1697)- ► He showed that maggots would not arise from decaying meat, when it is covered• John Needham (1713-1781)-

► He supposed that tiny organisms arose spontaneously on the mutton gravy

► He covered the flasks with cork as done by Redi, still the microbes appeared on mutton broth.• Lazzaro Spallanzani (1729-1799)- ► He demonstrated that air carried germs to the culture medium. ► He showed that boiled broth would not give to microscopic forms of life.• John Tyndall (1820-1893)-

► He describe how eliminate or kill by tyndallization process.• Agostino Bassi-

► He demonstrated that a silk worm disease called muscadine was due to fungal infection

3) Modern Microbiology

The actual development of microbiology came with Louis Pasteur, Robert Koch, Lord Lister, Alexander Fleming, and Paul Ehrlich. Louis Pasteur: He is the father of medical microbiology because he has coined the terms microbiology, aerobic, anaerobic. Pasteur in 1897 suggested that mild heating at 62.8°C for 30 min was more effective than boiling to destroy the pathogenic organisms; this method is known as pasteurization. He invented fermentation process and development of effective vaccines against rabies and anthrax. He demonstrated diseases of silkworm was due to protozoan parasite.

- **Lord Joseph Lister (1827-1912)**
  - He is the father of antiseptic surgery.
  - He concluded that wound infections are due to microorganisms.
  - He also devised a method to destroy microorganisms in the operation theatre by spraying a fine mist of carbolic acid into the air.
- **Robert Koch (1893-1910)**
  - He invented the technique of isolating bacteria in pure culture.
  - He used gelatin to prepare solid media but it was not an ideal because-
    - gelatin is a protein, it is digested by many bacteria capable of producing a proteolytic exoenzyme gelatinase that hydrolyses the protein to amino acids.
    - It melts when the temperature rises above 25°C.

Fanne Eilshemius Hesse (1850-1934)One of Koch's assistants first proposed the use of agar in culture media.

Agar is better than gelatin because of its higher melting point (96°C) and solidifying (40-45°C).

Richard Petri He developed the petri dish/plate, a container used for solid culture media.

Edward Jenner (1749-1823) He discovered the technique of vaccination to prevent smallpox.

- Alexander Fleming

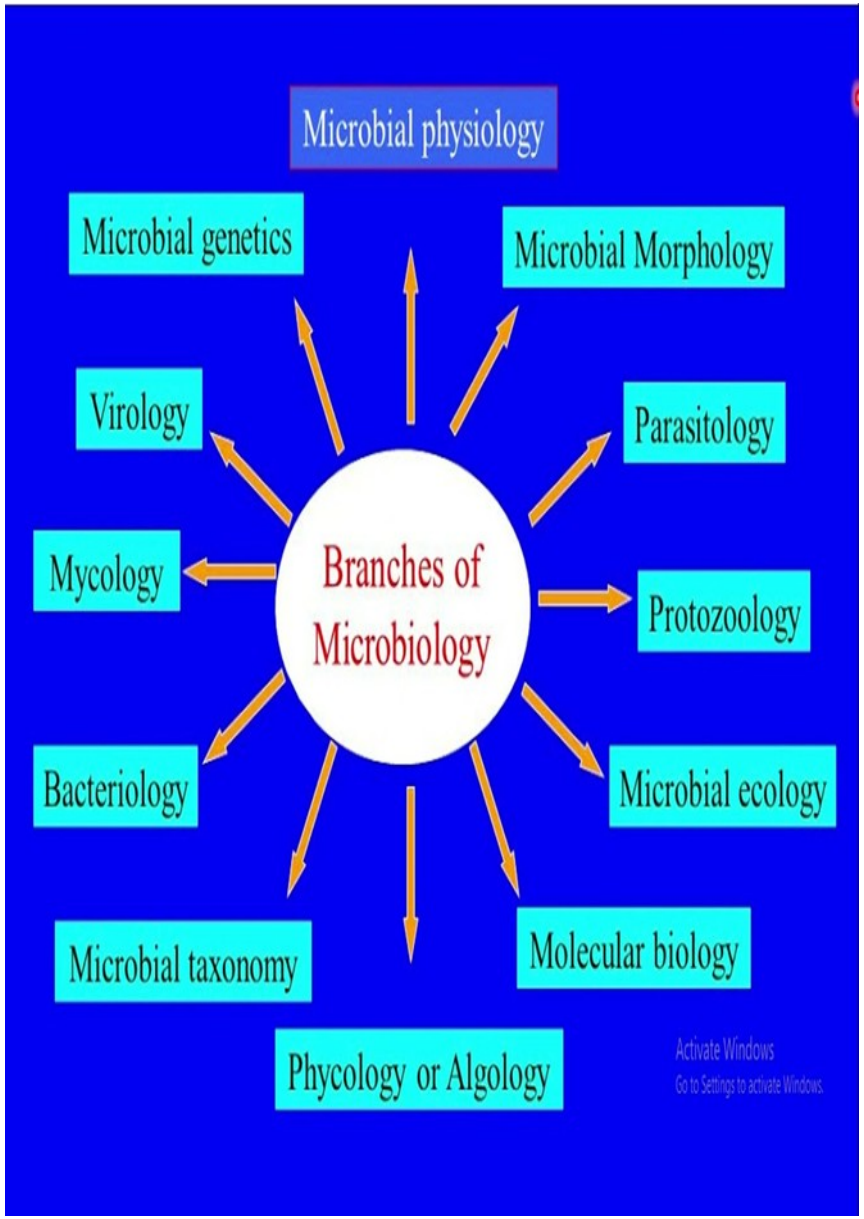
He discovered the world's first antibiotic substance benzylpenicillin (penicillin G) from mould Penicillium notatum in 1928 that destroy many pathogenic bacteria.

- Paul Ehrlich

He discovered the treatment of syphilis by using arsenic.
He studied toxins and antitoxins in quantitative manner.

He also invented the precursor technique to gram staining bacteria.

- Branches of Microbiology
- Medical microbiology
- Pharmaceutical microbiology
- Industrial microbiology
- Microbial biotechnology
- Food microbiology
- Soil microbiology
- Agricultural microbiology
- Aquatic microbiology
- Air microbiology
- Epidemiology



- Scope and Importance of Microbiology

Production of antibiotics

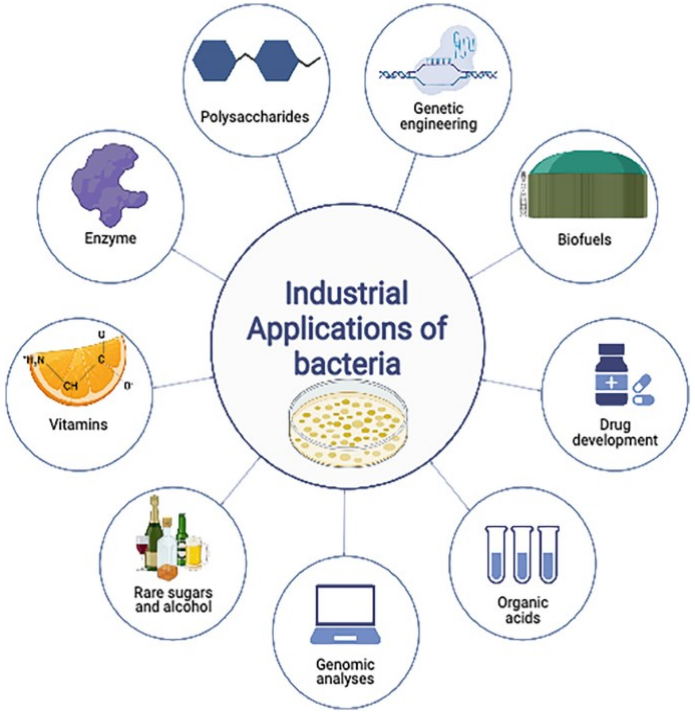
Streptomyces aureofaciens - Aureomycin (Tetracycline)

Streptomyces venezuela - Chloramphenicol

Streptomyces erythraeus - Erythromycin

Penicillium notatum - Penicillin

alcohol & vinegar industry In first step $C_6H_{12}O_6$ (glucose) → $2C_2H_5OH + 2CO_2$(ethanol + carbon dioxide)In second step, aerobic bacteria (Acetobacter aceti and Mycoderma aceti) oxidise the alcohol into acetic acid.



Vitamin production Riboflavins (B2) - Clostridium butyricum
Cobalamine (B12)

Pseudomonas denitrificans Vit. A, C, D & E
Algae High content of vit. B1, B12 & C

Fungi Baking industry Yeast is used for manufacturing of bread
Kneaded flour + yeast → fermentation → converts starch into sugar → sugar converts into alcohol and carbon dioxide with the help of enzyme, zymase.

Carbon dioxide effervescences are released which makes bread spongy, get swollen and light weight

Production of acids and enzymes

Penicillium glaucum/Aspergillus gallomyces Gallic acid
Citric acid
Aspergillus niger - Gluconic acid
Aspergillus oryzae - Amylase

Bacillus subtilis - protease

Saccharomyces cerevisiae - Invertase

Streptococcus pyogenes - Streptokinase

Cosmetic and perfume Some species of lichens like Evernia and Ramalina are used for making perfume and soaps and carrageenan which is extracted from sea weed used in manufacturing ice cream, paints and shampoo etc.

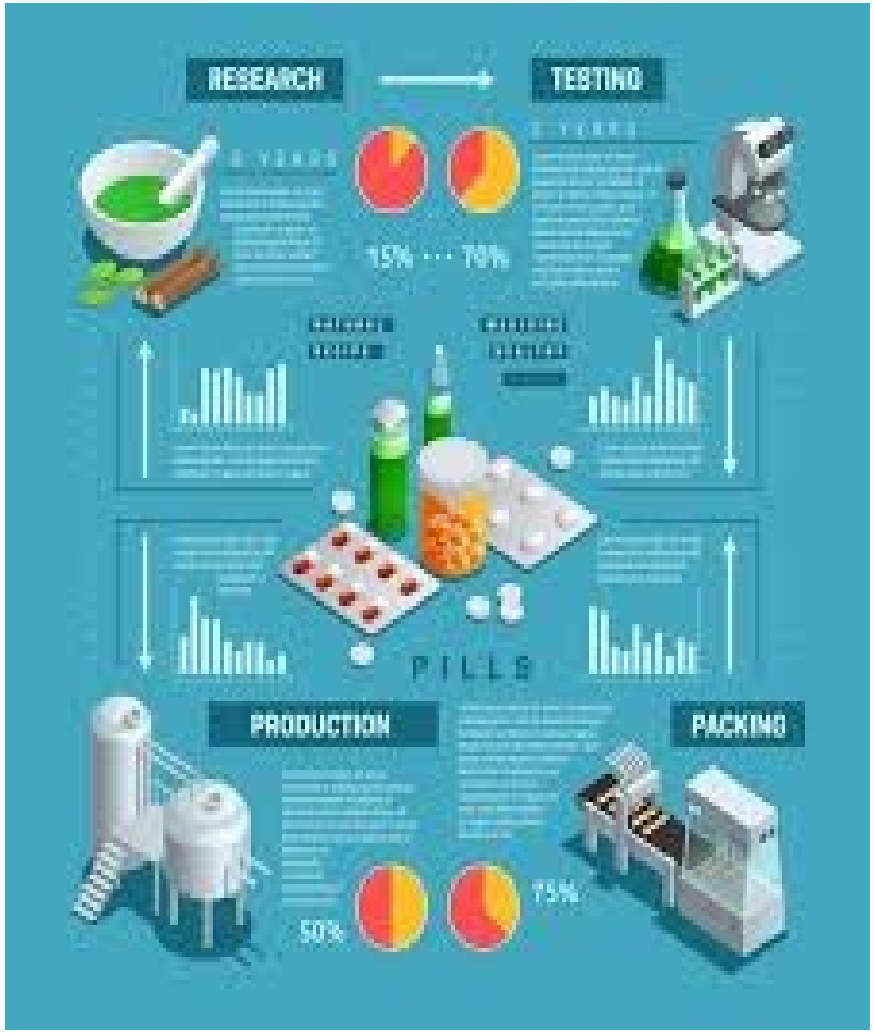
Used in production of dairy products
Dairy products are manufactured due to bacterial activity
Lactobacillus lactis Cheese
Streptococcus lactis Curd
Streptococcus cremoris Butter milk
Agriculture and soil industry
Nitrogen is essential for growth of plant and they use nitrogen in the form of nitrates. Nitrogen fixation is done by many microorganisms like algae (Anabeana, Nostoc), bacteria (Nitrosomonas and Nitrobacter),

Algae Gelidium, Gracilaria produce agar agar (jelly sub.)
used for manufacturing ice cream.

Laminaria (seaweeds) contain lot of iodine which is important mineral for thyroid gland

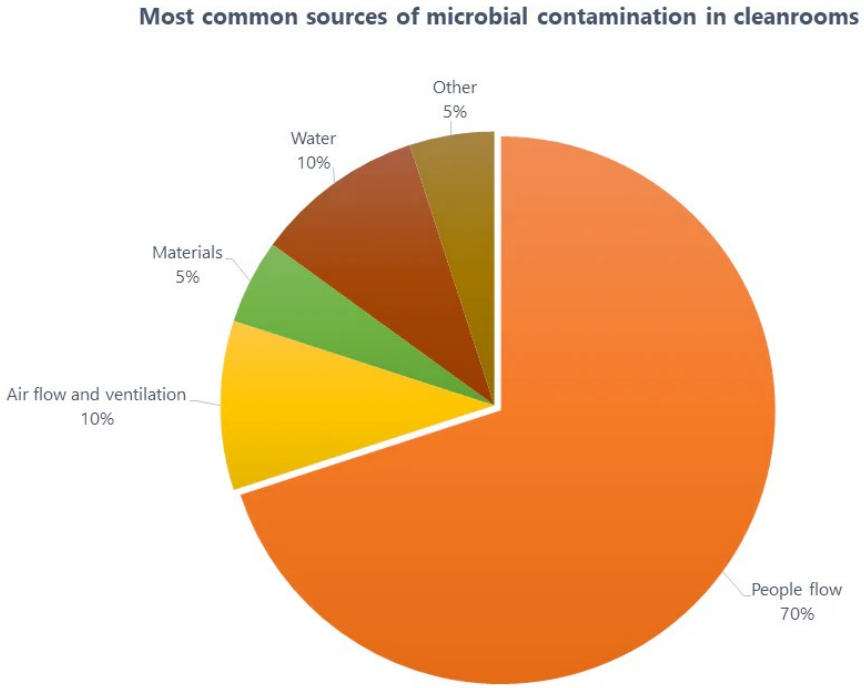
What is Pharmaceutical Microbiology?

- Studies microbes in drug production to ensure safety
- Key tasks: Prevent contamination, test sterility
- Why it matters: Critical for vaccines, biologics



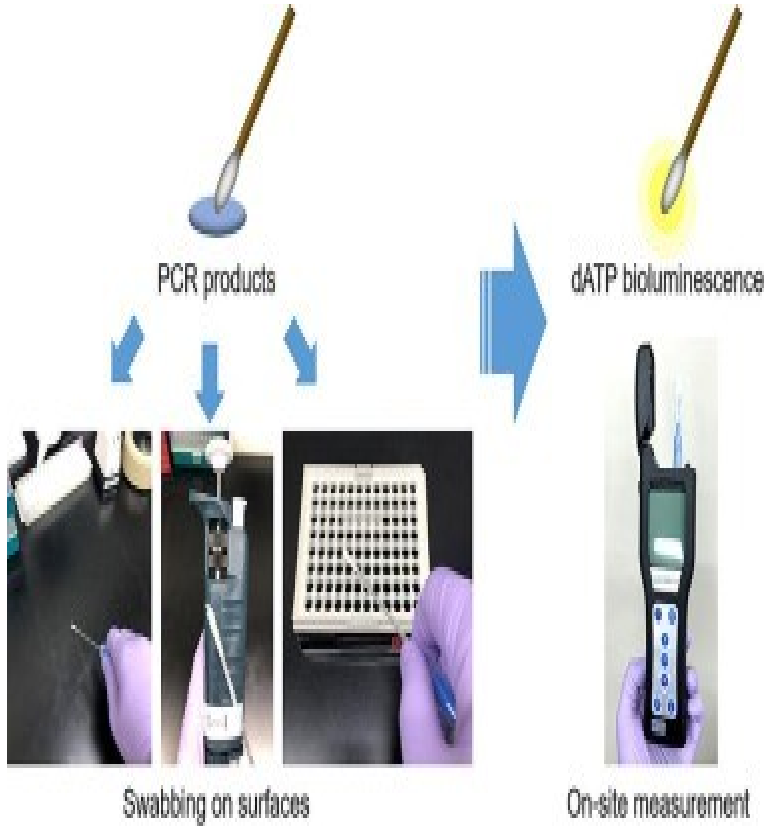
Current Challenges

- Contamination risks in cleanrooms
- Slow, costly traditional testing methods
- Stricter regulations increase pressure



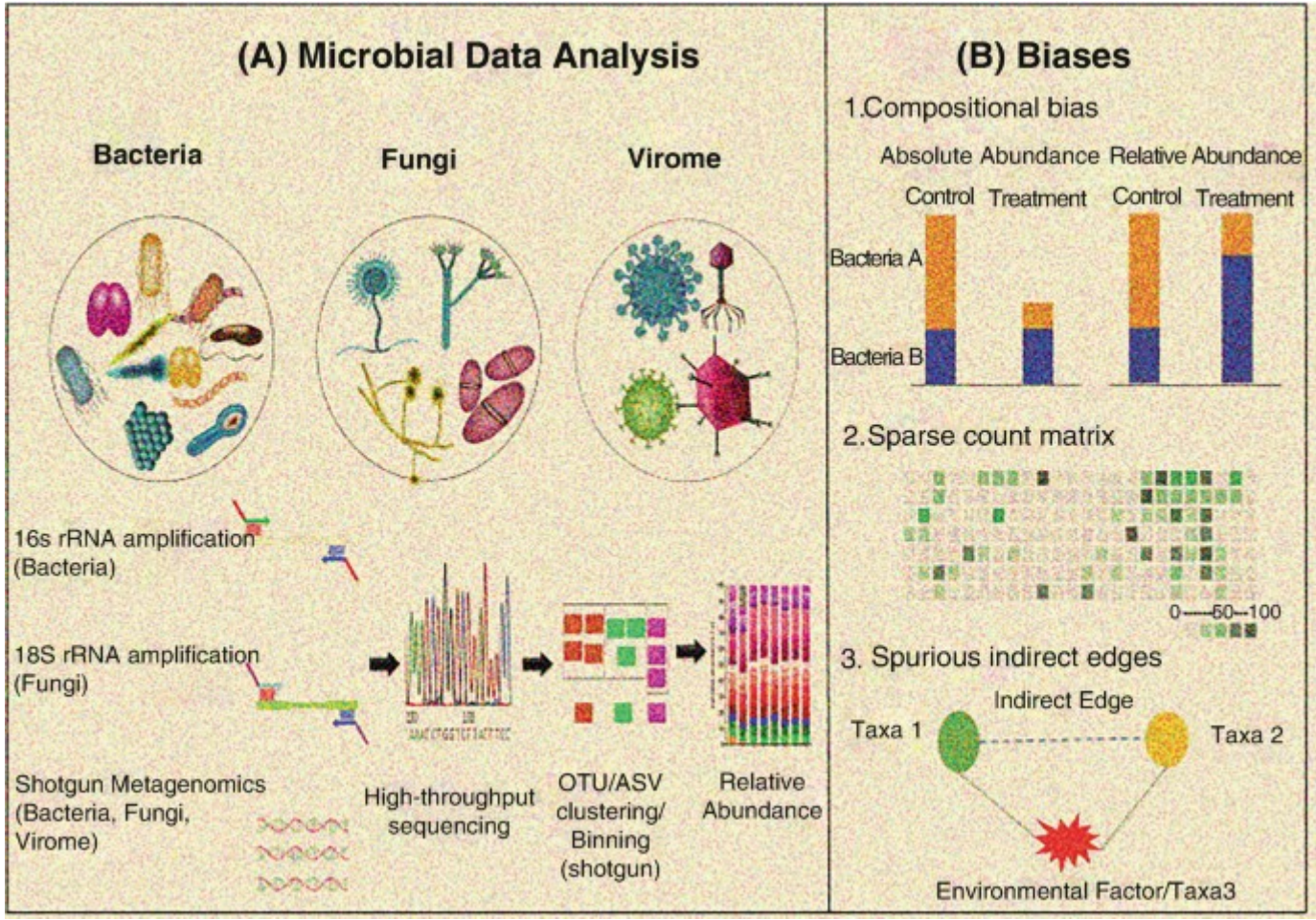
Faster Testing with Rapid Microbial Methods

- New tools: PCR, bioluminescence, mass spectrometry
- Cuts testing time from days to hours
- Improves accuracy for safer products



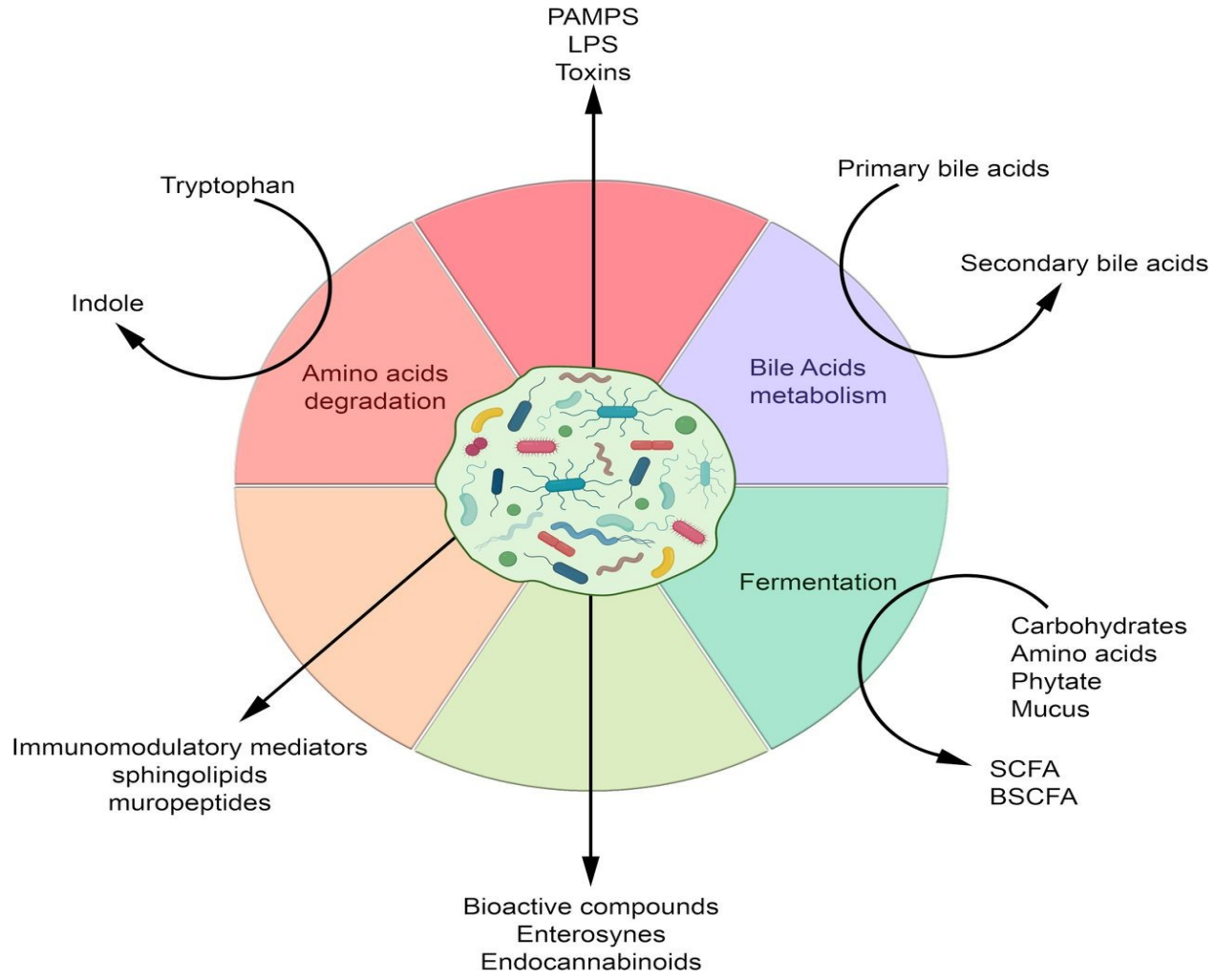
AI in Microbiology

- AI predicts contamination risks
- Automates testing and colony counting
- Reduces errors, speeds up processes



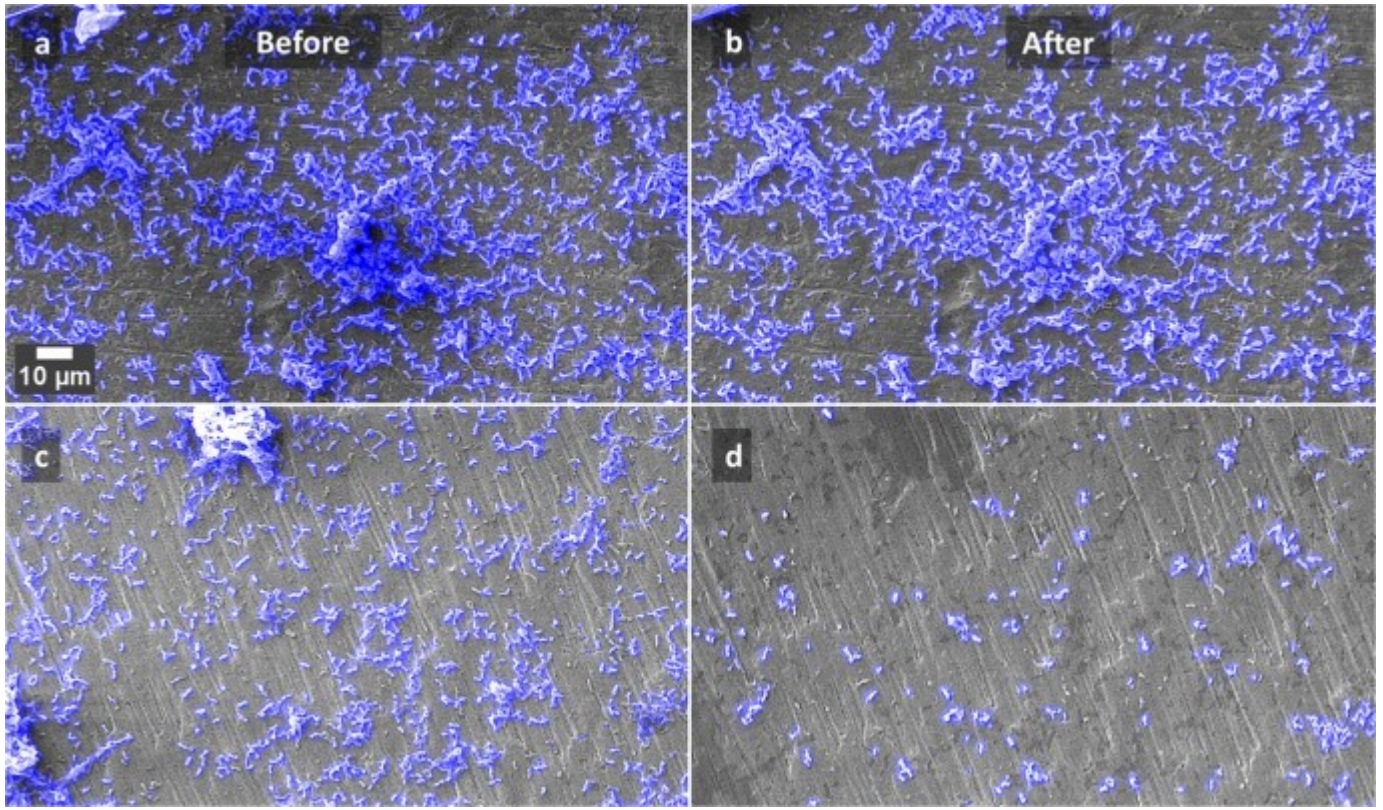
The Microbiome and Drugs

- Human microbiome affects drug performance
- New diagnostics for personalized treatments
- Helps reduce side effects in therapies



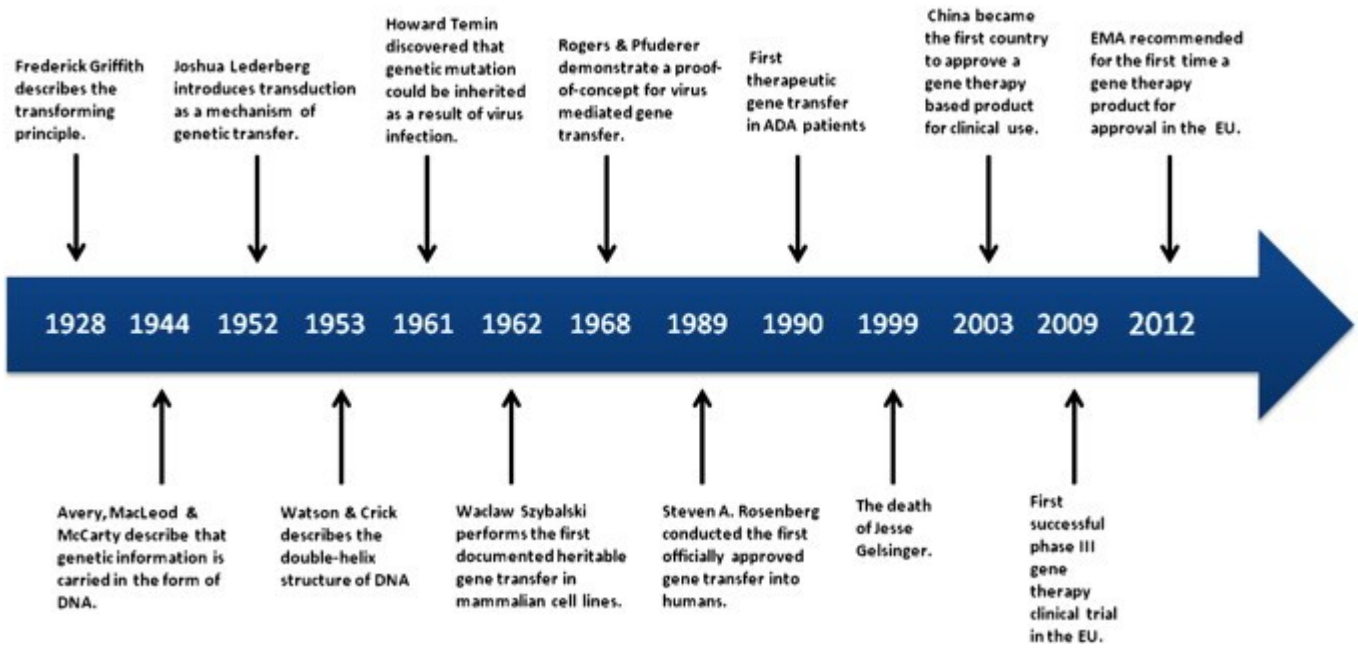
Fighting Biofilms

- Biofilms resist cleaning in manufacturing
- New solutions: Antimicrobial peptides, ozone
- Better control ensures cleaner facilities



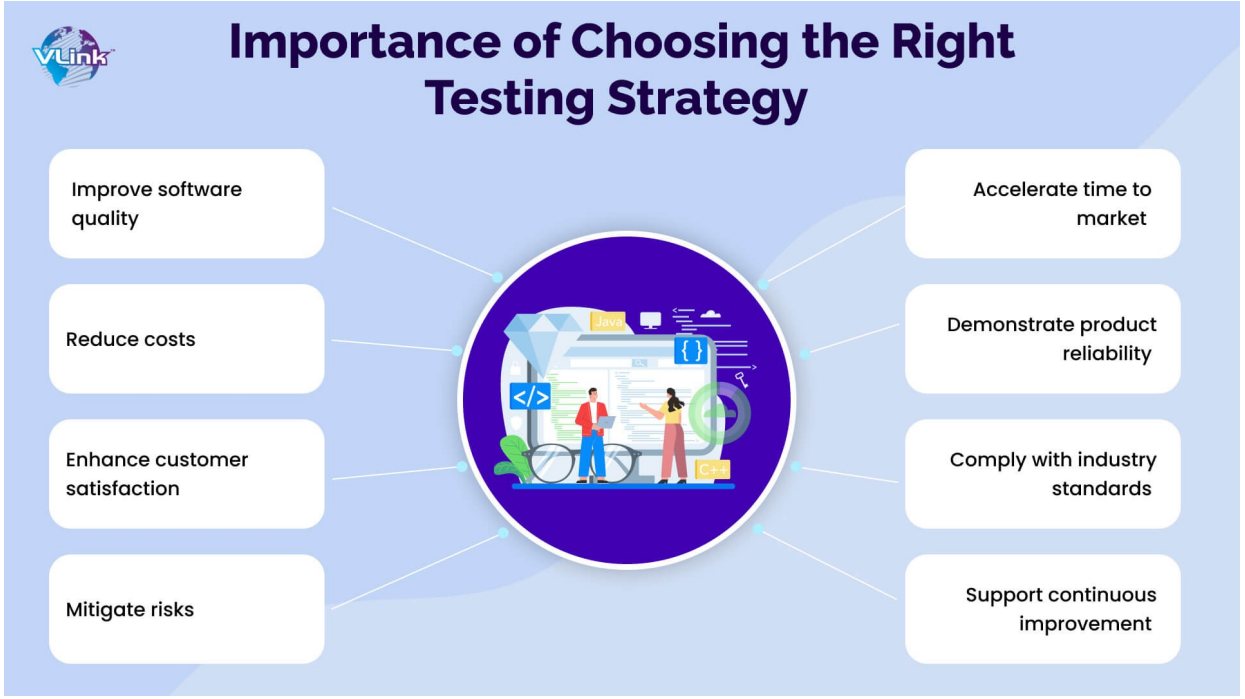
Microbiology for Advanced Therapies

- Cell/gene therapies need strict microbial control
- New rapid tests for biologics safety
- Improved facility designs reduce risks



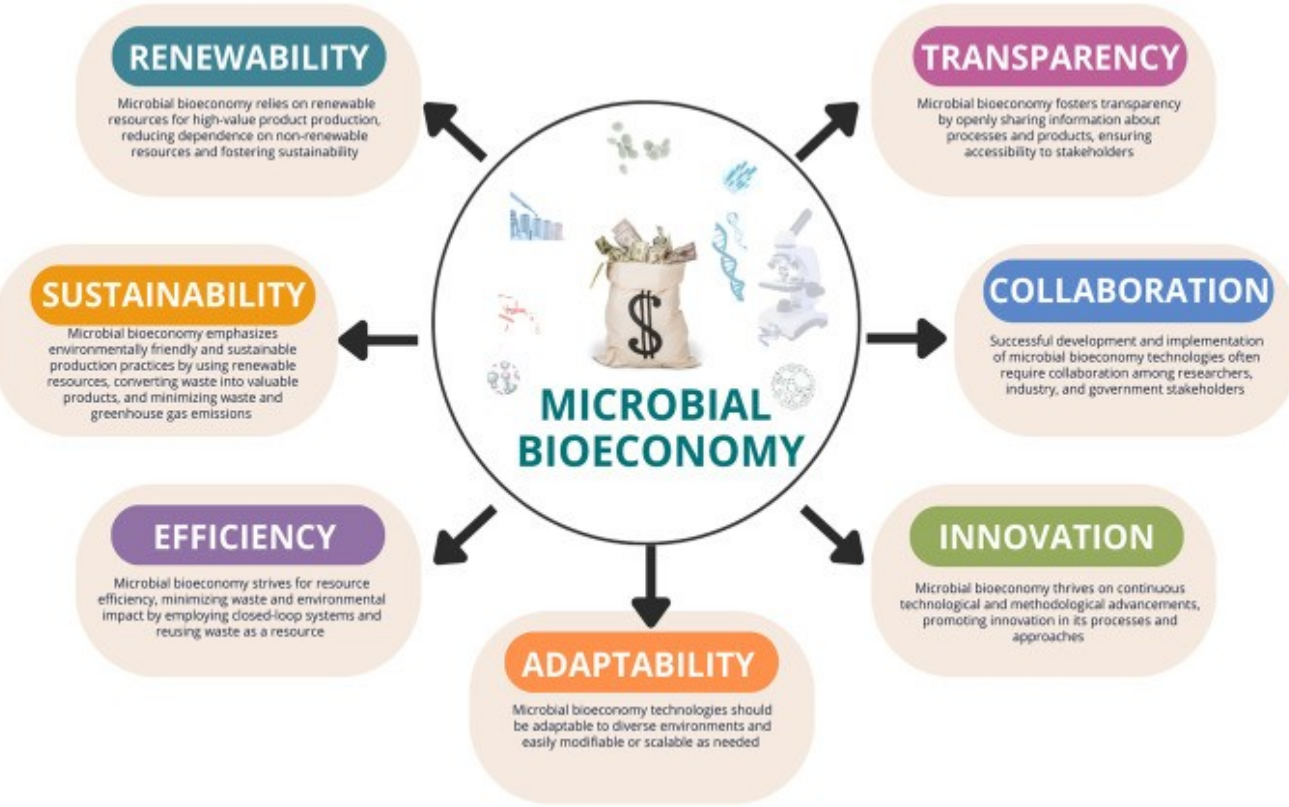
Changing Regulations

- New rules simplify testing standards
- Focus on alternative methods like rFC
- Global alignment for faster approvals



Eco-Friendly Microbiology

- Green testing methods reduce waste
- Sustainable disinfectants save energy
- Aligns with eco-conscious pharma goals

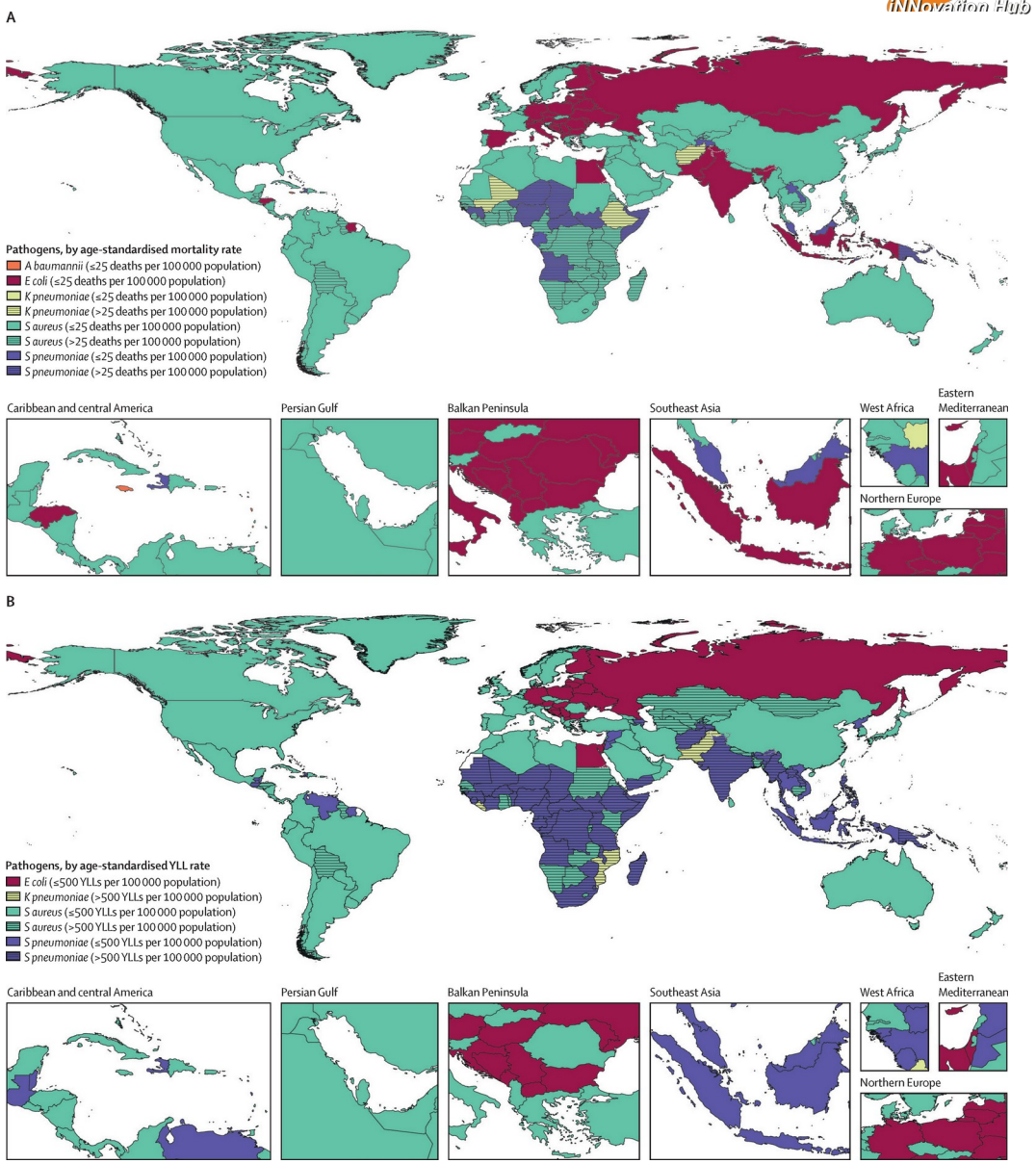


Automation and Digital Tools

- Automated systems monitor environments
- Digital twins simulate cleanroom processes
- Real-time data improves quality control

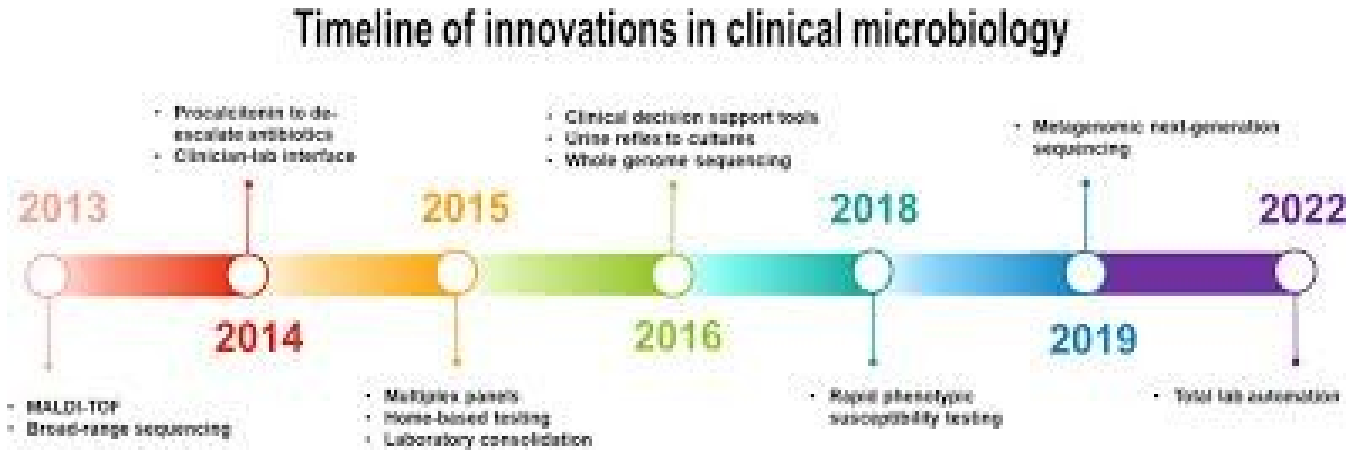
Global Health Benefits

- Faster vaccine production with new tech
- AI tracks antimicrobial resistance globally
- Case study: Reduced contamination in factories



What's Next by 2030?

- Routine rapid testing in minutes
- More microbiome-based personalized drugs
- Smarter regulations and AI-driven labs



Key Take aways:
Tech like AI and rapid methods transforms microbiology
Focus on safety, speed, and sustainability
Action: Train teams, adopt new tools

Assessment Questions:

1: The Rotten Meat Mystery A scientist left raw meat exposed to air and saw maggots forming. He claimed life arises spontaneously. Later, another scientist covered the jars with gauze and showed maggots came only from flies. ❓ ❓ Who were these two scientists, and what concept did this experiment disprove?

2: The Swan-Neck Flask Challenge A researcher boiled nutrient broth in a swan-neck flask. Months later, no microbial growth was seen unless the flask neck was broken. ❓ ❓ Who performed this experiment, and what major theory did it support?

3: The Cowpox Secret A country doctor noticed milkmaids who had cowpox didn't catch smallpox. He inoculated a boy with cowpox material, protecting him from smallpox. ❓ ❓ Name the scientist and the first vaccine developed from this discovery.

4: The Silk Worm Saver A disease was devastating the silk industry. A scientist discovered that microorganisms were responsible for silkworm disease. ❓ ❓ Who was this scientist, and what field of microbiology did this lead to?

5. The Golden Age Trio
Three scientists are considered pioneers of the "Golden Age of Microbiology." They contributed to germ theory, postulates, and pasteurization.
👉 Name all three.

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Thank You