

# HISTORY AND SCOPE OF MICROBIOLOGY

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# Microbiology?

- Study of **Microorganisms**
- Microorganisms are tiny creatures which can not be seen by the naked eye and can only be visualized under **microscope**

# Branches of Microbiology

- Pure Microbiology
  - ▣ Taxonomic arrangement
  - ▣ Integrative arrangement
- Applied Microbiology

# Branches of Microbiology

## **Taxonomic Arrangement:**

- Bacteriology
- Mycology
- Phycology
- Virology
- Protozoology
- Immunology

# Branches of Microbiology

## **Integrative Arrangement:**

- ❑ Microbial cytology
- ❑ Microbial physiology
- ❑ Microbial genetics
- ❑ Microbial ecology
- ❑ Microbial taxonomy
- ❑ Cellular Microbiology
- ❑ Molecular Microbiology

*History and scope of Microbiology*



# Branches of Microbiology

## Applied Microbiology:

- Medical Microbiology
- Veterinary Microbiology
- Public Health Microbiology
- Industrial Microbiology
- Pharmaceutical Microbiology
- Agriculture Microbiology
  - ▣ Plant Microbiology
  - ▣ Soil Microbiology

# Branches of Microbiology

## Applied Microbiology:

- ❑ Food and Dairy Microbiology
- ❑ Environmental Microbiology
- ❑ Water/Aquatic Microbiology
- ❑ Aero-microbiology
- ❑ Microbial Biotechnology
- ❑ Vaccinology
- ❑ Chemotherapy

*History and scope of Microbiology*



# Naming Microorganisms

To identify all species of life on Earth

Linnaeus – (1707-1778) Father of modern taxonomy

Created Binomial nomenclature

2 names- *Genus-species*

Names are italicized or underlined. The genus is capitalized and the specific epithet is lower case.

# Naming Microorganisms

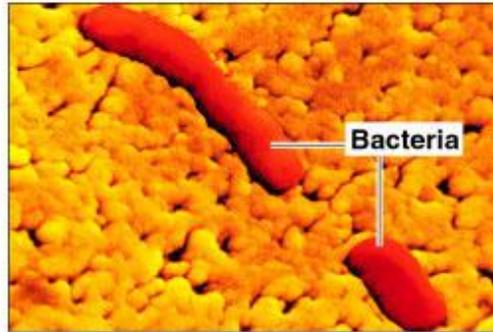
Names may be descriptive or honor a scientist:

- *Staphylococcus aureus*
  - Describes the clustered arrangement of the cells (staphylo-) and the golden color of the colonies.
- *Escherichia coli*
  - Honors the discoverer, Theodor Escherich, and describes the bacterium's habitat, the large intestine or colon.

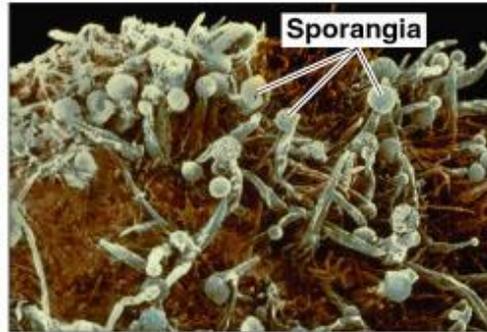
# Naming Microorganisms

- After the first use, scientific names may be abbreviated with the first letter of the genus and the specific epithet:
  - *Staphylococcus aureus* and *Escherichia coli* are found in the human body. *S. aureus* is on skin and *E. coli*, in the large intestine.

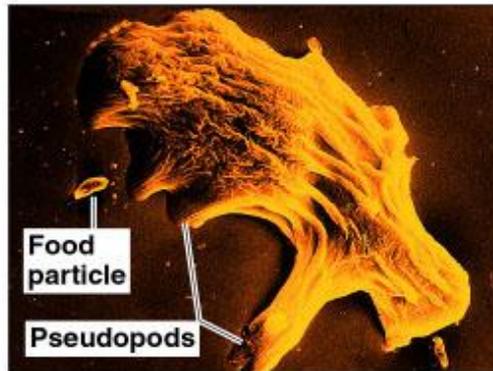
# Microorganisms?



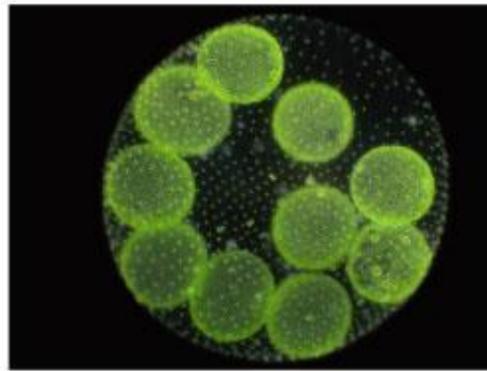
(a)



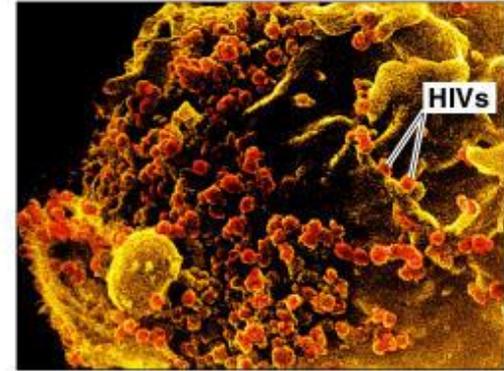
(b)



(c)



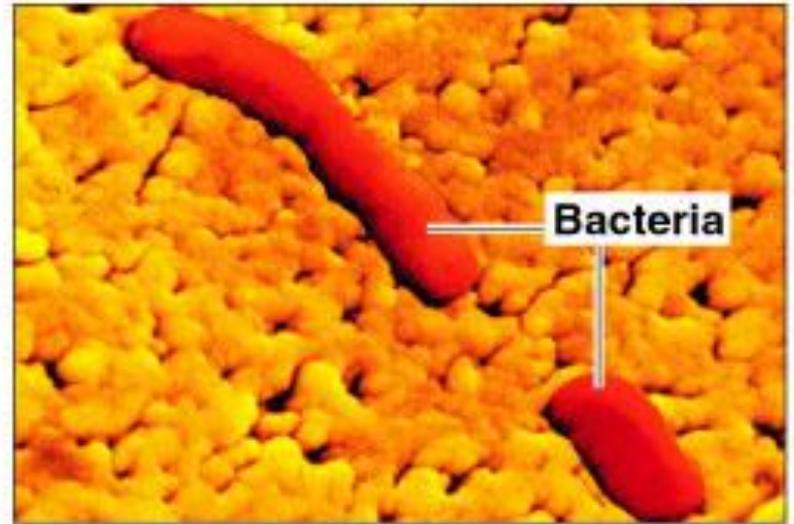
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(e)

# Bacteria

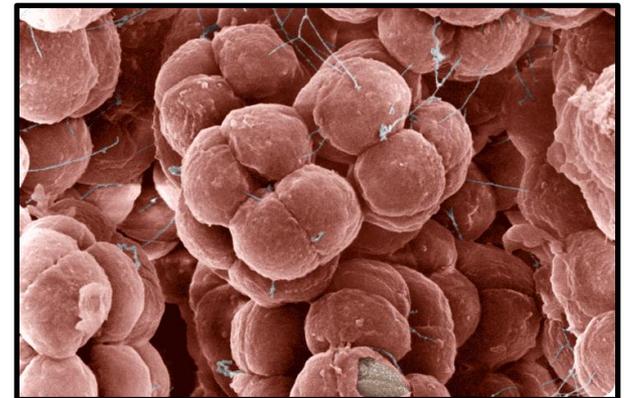
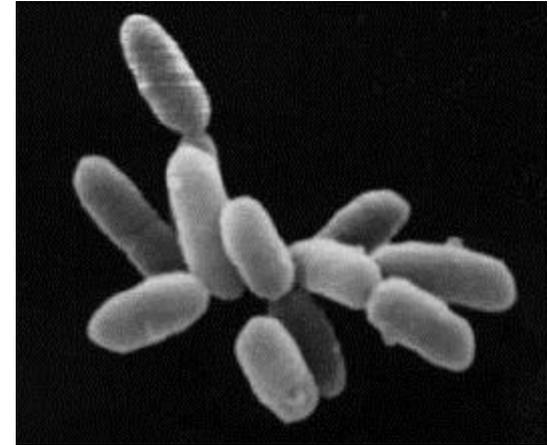
- Prokaryotes
- Peptidoglycan cell walls
- Binary fission
- For energy, use organic chemicals, inorganic chemicals, or photosynthesis



# Archaea

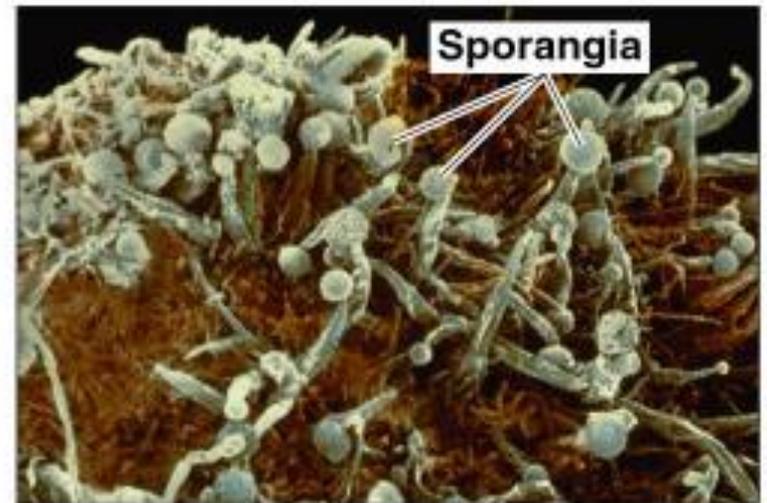
- Prokaryotic
- Lack peptidoglycan
- Live in extreme environments
- Include:
  - ▣ Methanogens
  - ▣ Extreme halophiles
  - ▣ Extreme thermophiles  
(Taq polymerase)

**Non-pathogenic**



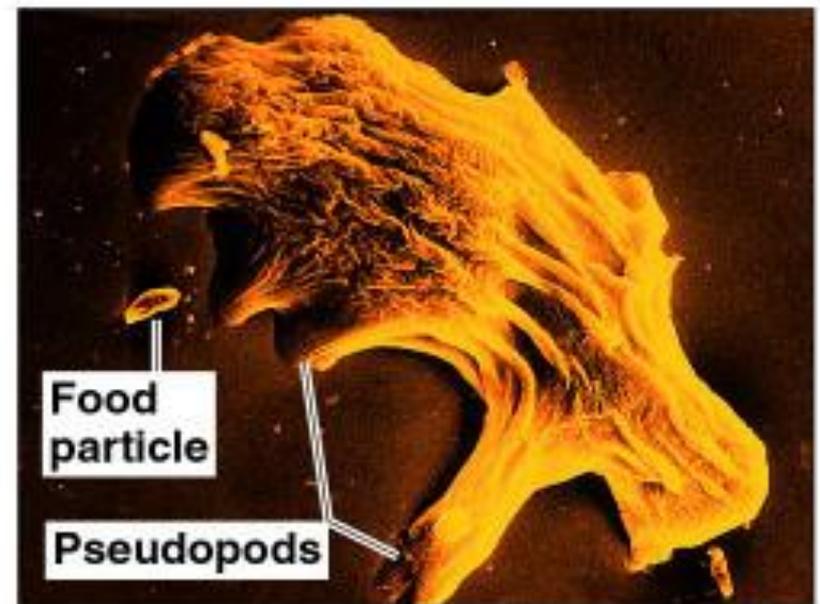
# Fungi

- Eukaryotes
- Chitin cell walls
- Use organic chemicals for energy
- **Yeasts** are unicellular
- **Molds** and mushrooms
  - Multicellular
  - Hyphae



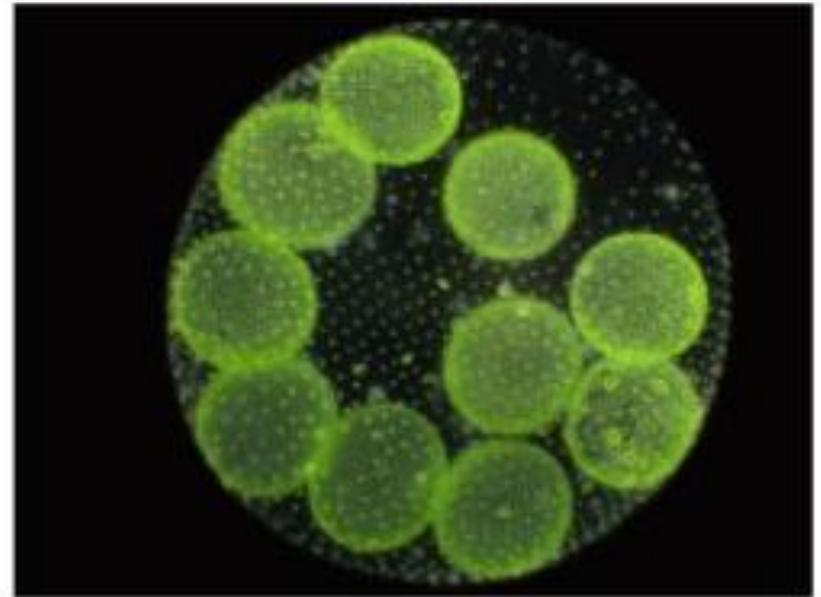
# Protozoa

- Eukaryotes
- Absorb or ingest organic chemicals
- May be motile via pseudopods, cilia, or flagella



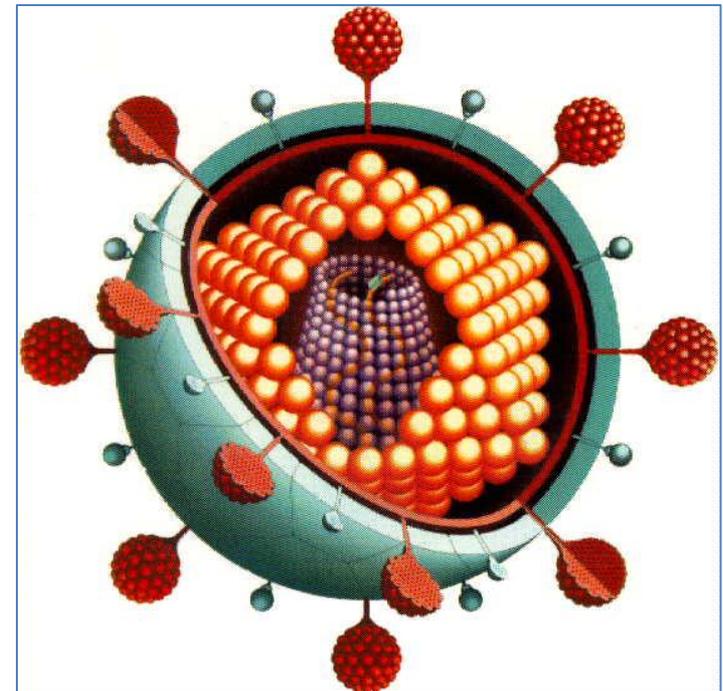
# Algae

- ❑ Eukaryotes
- ❑ Cellulose cell walls
- ❑ Use photosynthesis for energy
- ❑ Produce molecular oxygen and organic compounds



# Virus

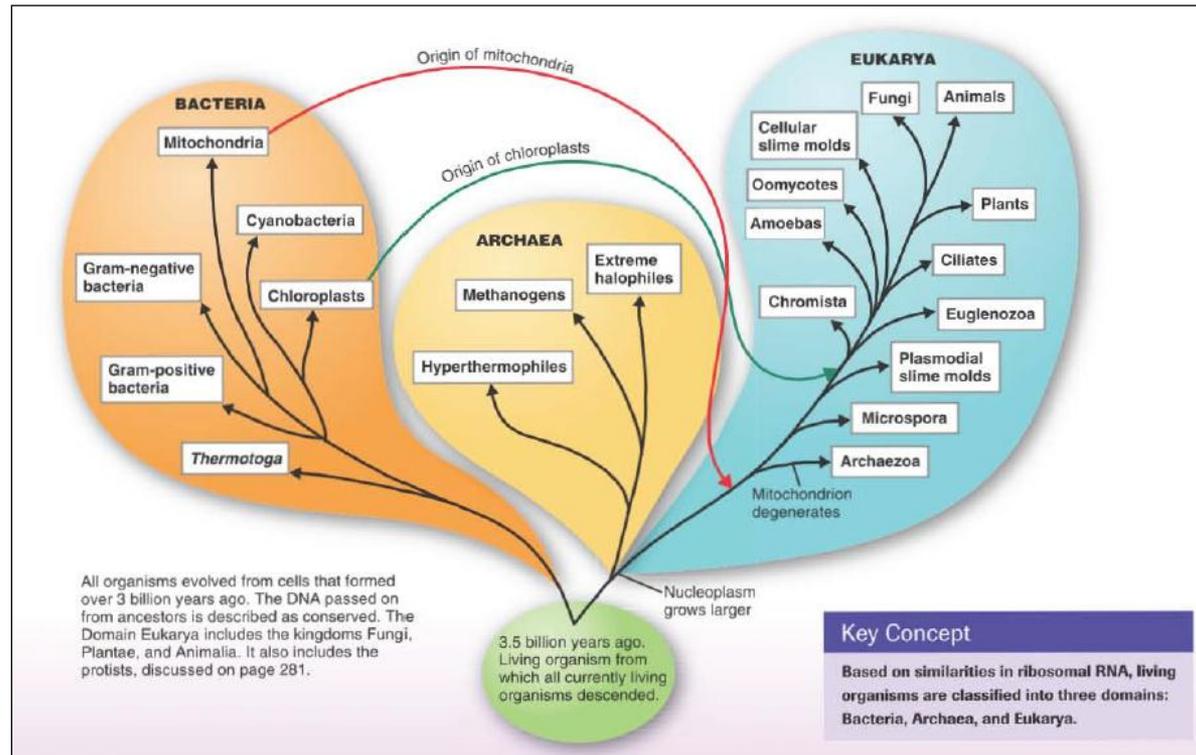
- ❑ Acellular
- ❑ Consist of DNA *or* RNA core
- ❑ Core is surrounded by a protein coat
- ❑ Coat may be enclosed in a lipid envelope
- ❑ Viruses are replicated only when they are in a living host cell



# Classification of Microorganisms

- In 1978, Carl Woese devised system based upon the **cellular organization** of the organisms in 3 domains

- ▣ Bacteria
  - ▣ Archaea
  - ▣ Eukarya
    - Protists
    - Fungi
    - Plants
    - Animals

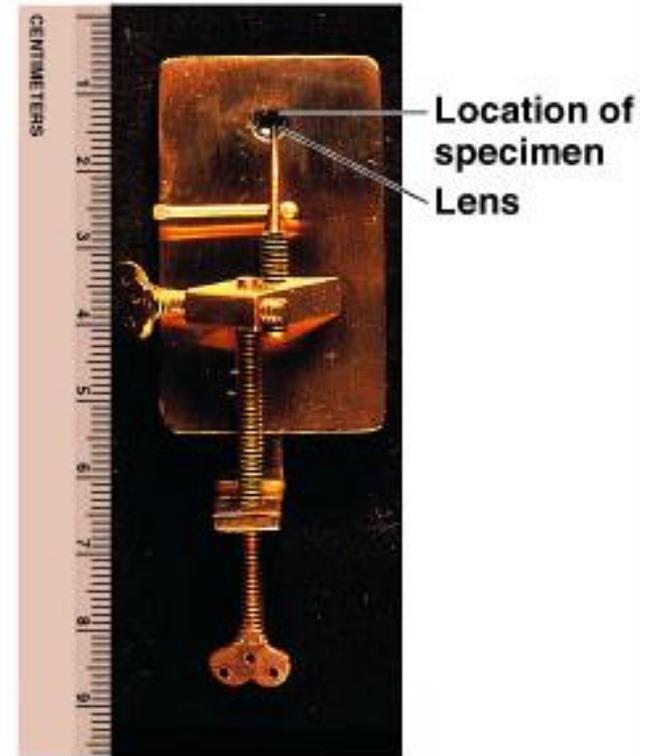


# Cell Theory

- In 1665, Robert Hooke reported that living things were composed of little boxes or cells.
- In 1858, Rudolf Virchow said cells arise from preexisting cells.
- Cell Theory. All living things are composed of cells and come from preexisting cells

# First observation of microbes

- 1673-1723, Antoni van Leeuwenhoek described live microorganisms that he observed (**Animalcules**)
  - Teeth scrapings
  - Rain water
  - Peppercorn infusions.



**(b)** Microscope replica

# The Debate Over Spontaneous Generation

- The hypothesis that living organisms arise from nonliving matter is called **spontaneous generation**. According to spontaneous generation, a “**vital force**’ forms life.
- The Alternative hypothesis, that the living organisms arise from preexisting life, is called **biogenesis**.

# Evidence Pro and Con

- 1668: **Francisco Redi** filled six jars with decaying meat.

Conditions	Results
3 jars covered with fine net	No maggots
3 open jars	Maggots appeared

From where did the maggots come?  
What was the purpose of the sealed jars?  
*Spontaneous generation or biogenesis?*

# Evidence Pro and Con

- 1745: **John Needham** put boiled nutrient broth into covered flasks.

<b>Conditions</b>	<b>Results</b>
Nutrient broth heated, then placed in sealed flask	Microbial growth
From where did the microbes come? <i>Spontaneous generation or biogenesis?</i>	

# Evidence Pro and Con

- 1765: **Lazzaro Spallanzani** boiled nutrient solutions in flasks.

<b>Conditions</b>	<b>Results</b>
Nutrient broth placed in flask, heated, then sealed	No microbial growth
<i>Spontaneous generation or biogenesis?</i>	

# Evidence Pro and Con

- 1861: **Louis Pasteur** demonstrated that microorganisms are present in the air.

Conditions	Results
Nutrient broth placed in flask, heated, not sealed	Microbial growth
Nutrient broth placed in flask, heated, then sealed	No microbial growth
<i>Spontaneous generation or biogenesis?</i>	

# The Theory of Biogenesis

Pasteur's S-shaped flask kept microbes out but let air in.



# Golden age of Microbiology

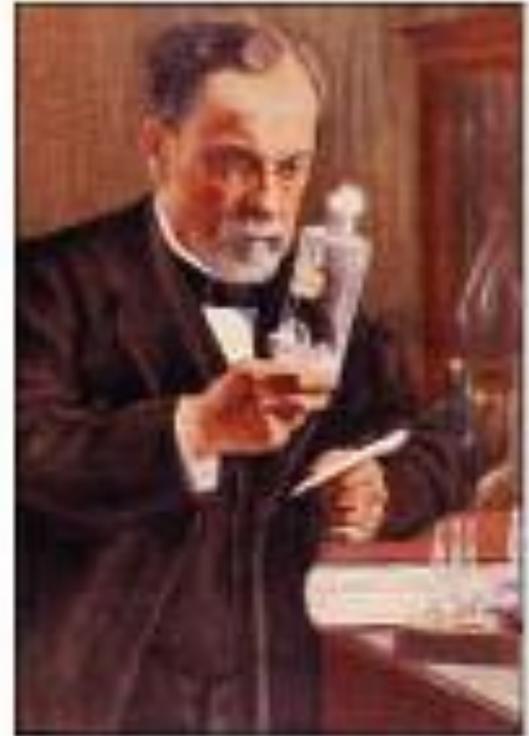
- **1857-1914**
- Beginning with Pasteur's work, discoveries included the relationship between microbes and disease, immunity, and antimicrobial drugs

# Fermentation and Pasteurization

- ❑ Pasteur showed that microbes are responsible for fermentation.
- ❑ Fermentation is the conversion of sugar to alcohol to make beer and wine.
- ❑ Microbial growth is also responsible for spoilage of food.
- ❑ Bacteria that use alcohol and produce acetic acid spoil wine by turning it to vinegar (acetic acid).

# Fermentation and Pasteurization

- Pasteur demonstrated that these spoilage bacteria could be killed by heat that was not hot enough to evaporate the alcohol in wine. This application of a high heat for a short time is called **pasteurization**.



# The Germ Theory of Disease

- **1835:** **Agostino Bassi** showed a silkworm disease was caused by a fungus.
- **1865:** **Pasteur** believed that another silkworm disease was caused by a protozoan.
- **1840s:** **Ignaz Semmelwise** advocated handwashing to prevent transmission of puerperal fever from one obstetric patient to another.

# The Germ Theory of Disease

- **1860s: Joseph Lister** used a chemical disinfectant to prevent surgical wound infections after looking at Pasteur's work showing microbes are in the air, can spoil food, and cause animal diseases.
- **1876: Robert Koch** provided proof that a bacterium causes anthrax and provided the experimental steps, Koch's postulates, used to prove that a specific microbe causes a specific disease.

# The Germ Theory of Disease

## Koch's postulates

- ❑ Pathogen must be present in all cases of disease
- ❑ Pathogen must be isolated and grown in lab in pure culture
- ❑ Pathogen from pure cultures must cause disease when inoculated into healthy, susceptible lab animal
- ❑ Same pathogen must be isolated from the diseased lab animal

# Vaccination

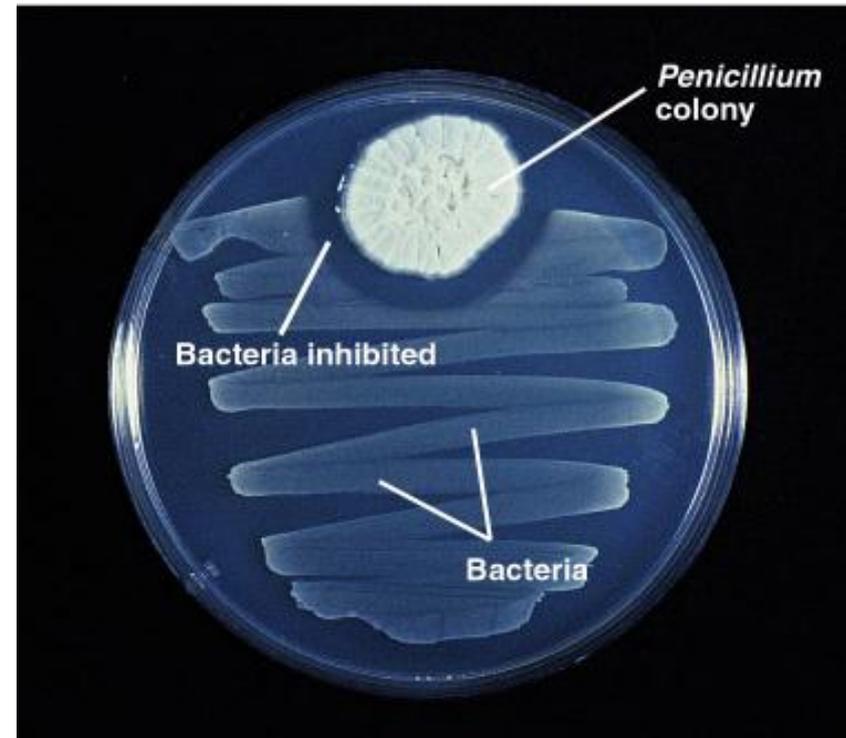
- 1796: Edward Jenner inoculated a person with cowpox virus. The person was then protected from smallpox.
- Called vaccination from *vacca* for cow
- The protection is called immunity

# The Birth of Modern Chemotherapy

- ❑ Treatment with chemicals is chemotherapy.
- ❑ Chemotherapeutic agents used to treat infectious disease can be synthetic drugs or antibiotics.
- ❑ Antibiotics are chemicals produced by bacteria and fungi that inhibit or kill other microbes.
- ❑ Quinine from tree bark was long used to treat malaria.
- ❑ 1910: Paul Ehrlich developed a synthetic arsenic drug, salvarsan, to treat syphilis.
- ❑ 1930s: Sulfonamides were synthesized.

# The Birth of Modern Chemotherapy

- ❑ 1928: Alexander Fleming discovered the first antibiotic.
- ❑ He observed that *Penicillium* fungus made an antibiotic, penicillin, that killed *S. aureus*.
- ❑ 1940s: Penicillin was tested clinically and mass produced.



THANK YOU