

# Fields of Microbiology

Packet #5

# The Golden Age of Microbiology

- Tell Me Why

- Some people consider **Pasteur or Koch** to be the **father(s) of Microbiology**, rather than Leeuwenhoek. Why might they be correct?

Table 1.3 Fields of Microbiology (1 of 2)

**TABLE 1.3 Fields of Microbiology**

<b>Disciplines</b>	<b>Subject(s) of Study</b>
<b>Basic Research</b>	
<b><i>Microbe Centered</i></b>	
Bacteriology	Bacteria and archaea
Phycology	Algae
Mycology	Fungi
Protozoology	Protozoa
Parasitology	Parasitic protozoa and parasitic animals
Virology	Viruses
<b><i>Process Centered</i></b>	
Microbial metabolism	Biochemistry: chemical reactions within cells
Microbial genetics	Functions of DNA and RNA
Environmental microbiology	Relationships between microbes and among microbes, other organisms, and their environment

Table 1.3 Fields of Microbiology (2 of 2)

**TABLE 1.3 Fields of Microbiology**

<b>Disciplines</b>	<b>Subject(s) of Study</b>
<b>Applied Microbiology</b>	
<b>Medical Microbiology</b>	
Serology	Antibodies in blood serum, particularly as an indicator of infection
Immunology	Body's defenses against specific diseases
Epidemiology	Frequency, distribution, and spread of disease
Etiology	Causes of disease
Infection control	Hygiene in health care settings and control of nosocomial infections
Chemotherapy	Development and use of drugs to treat infectious diseases
<b>Applied Environmental Microbiology</b>	
Bioremediation	Use of microbes to remove pollutants
Public health microbiology	Sewage treatment, water purification, and control of insects that spread disease
Agricultural microbiology	Use of microbes to control insect pests
<b>Industrial Microbiology (Biotechnology)</b>	
Food and beverage technology	Reduction or elimination of harmful microbes in food and drink
Pharmaceutical microbiology	Manufacture of vaccines and antibiotics
Recombinant DNA technology (genetic engineering)	Alteration of microbial genes to synthesize useful products

# The Modern Age of Microbiology

- What Are the Basic Chemical Reactions of Life?
  - Biochemistry
    - Began with **Pasteur's** work on **fermentation** and **Buchner's** discovery of **enzymes in yeast extract**
    - **Kluyver and van Niel**—microbes used as model systems for biochemical reactions
    - Practical applications:
      - Design of herbicides and pesticides
      - Diagnosis of illnesses and monitoring of patients' responses to treatment
      - Treatment of metabolic diseases
      - Drug design

# The Modern Age of Microbiology

- How Do Genes Work?
  - Microbial genetics
  - Molecular biology
  - Recombinant DNA technology
  - Gene therapy

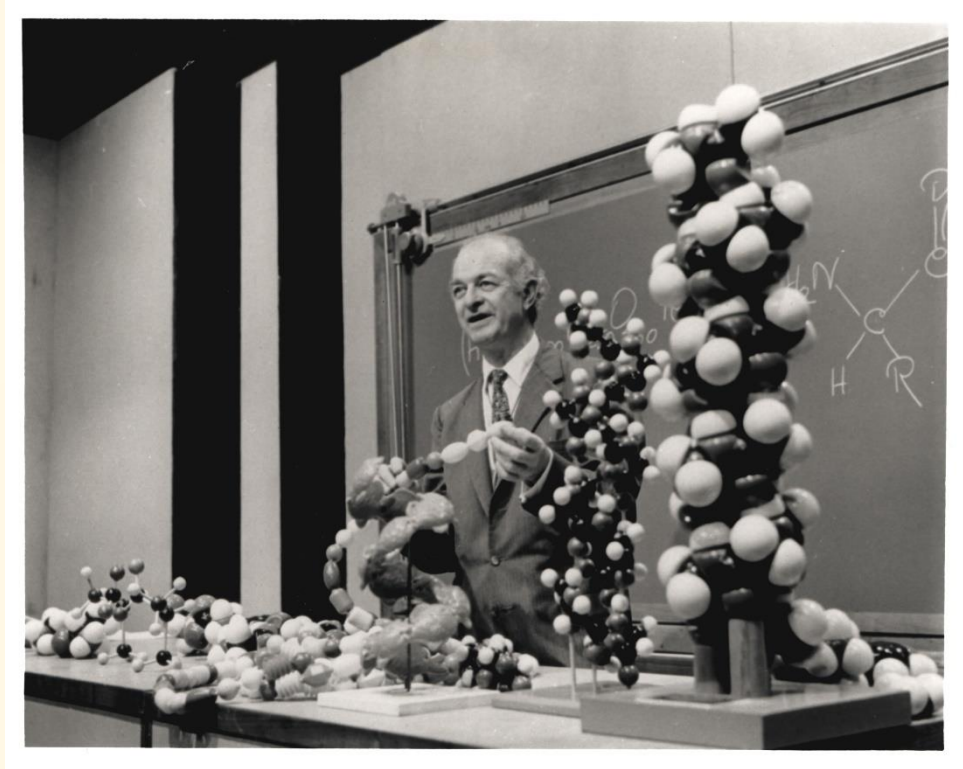
# The Modern Age of Microbiology

- How Do Genes Work?
  - **Microbial genetics**
    - **Avery, MacLeod, and McCarty** determined **genes** are **contained in molecules of DNA**.
    - **Beadle and Tatum** established that a **gene's activity is related to protein function**.
    - Translation of genetic information into protein explained
    - Rates and mechanisms of genetic mutation investigated
    - Identify methods cells use to control genetic expression



# The Modern Age of Microbiology

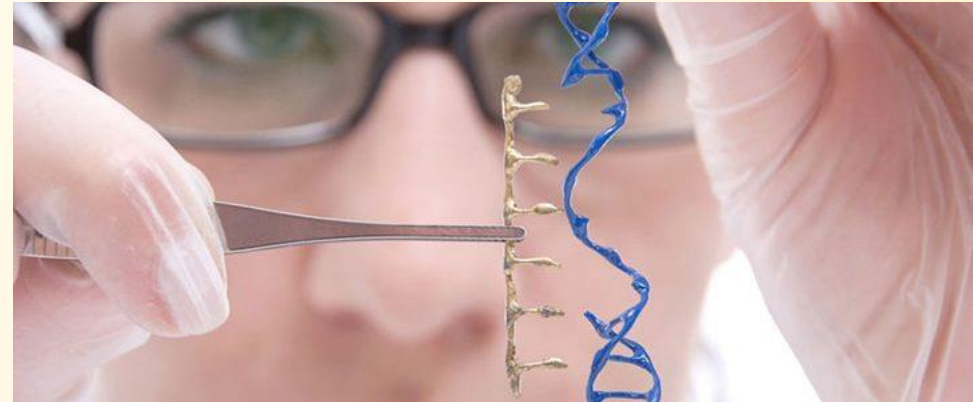
- How Do Genes Work?
  - **Molecular biology**
    - Explanation of cell function at the molecular level
    - **Pauling** proposed that **gene sequences** could:
      - Provide understanding of evolutionary relationships and processes
      - Establish taxonomic categories to reflect these relationships
      - Identify existence of microbes that have never been cultured
    - **Woese and Fox** determined cells can be categorized as bacteria, archaea, or eukaryotes.
    - Cat scratch disease caused by unculturable organism





# The Modern Age of Microbiology

- How Do Genes Work?
  - **Recombinant DNA technology**
    - Genes in microbes, plants, and animals manipulated for practical applications
    - Production of human blood-clotting factor by *E. coli* to aid hemophiliacs
  - **Gene therapy**
    - Inserting a missing gene or repairing a defective one in humans by inserting desired gene into host cells



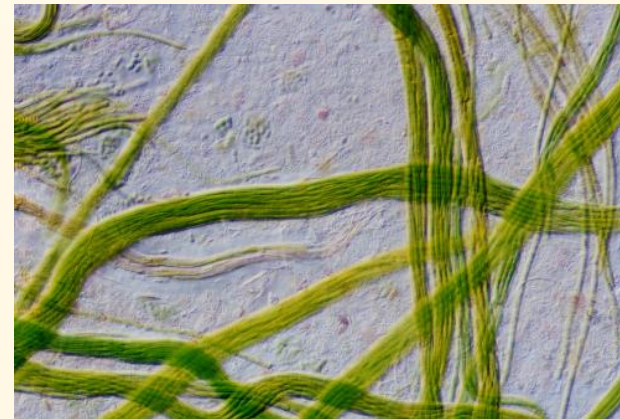
# The Modern Age of Microbiology

- What Role Do Microorganisms Play in the Environment?
  - **Bioremediation** uses living bacteria, fungi, and algae to detoxify polluted environments.
  - **Recycling of chemicals** such as carbon, nitrogen, and sulfur
  - **Causation of disease**

# Recycling of Chemicals

## Remember...

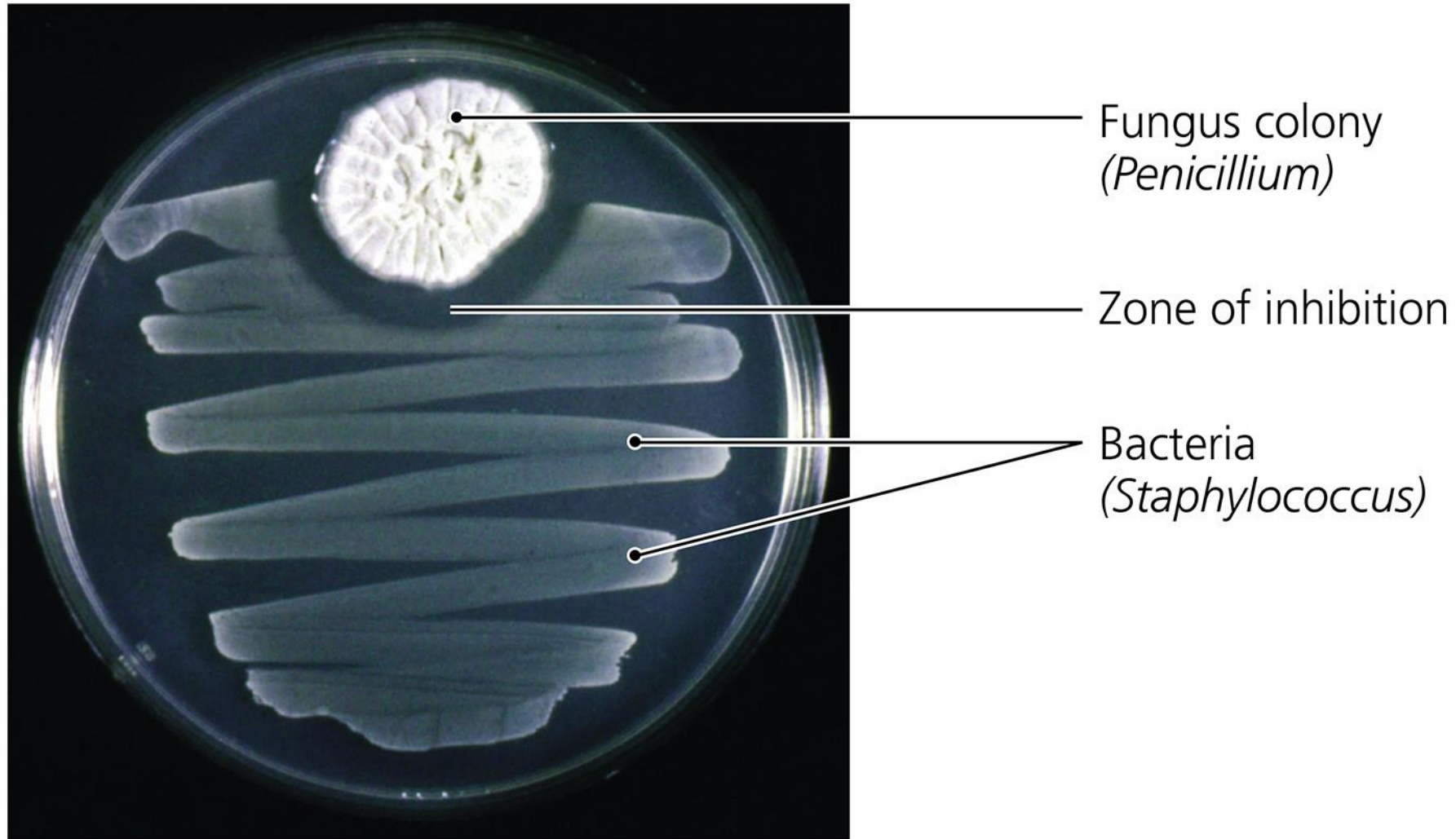
- **Cyanobacteria**
  - Converts Nitrogen gas into ammonia, nitrates or nitrites
    - Part of the **Nitrogen Cycle**
  - **Found in the rice patties of Asia (where rice is grown)**
    - Rice feeds 75% of the human population
  - Some species produce toxins dangerous to humans



# The Modern Age of Microbiology

- How Do We Defend Against **Disease**?
  - **Serology**
    - The study of blood serum
    - **Von Behring and Kitasato** – existence in the blood of chemicals and cells that fight infection
  - **Immunology**
    - The study of the body's defenses against specific pathogens
  - **Chemotherapy**
    - **Fleming** discovered penicillin.
    - **Domagk** discovered sulfa drugs.

Figure 1.20 The effects of penicillin on a bacterial “lawn” in a Petri dish.

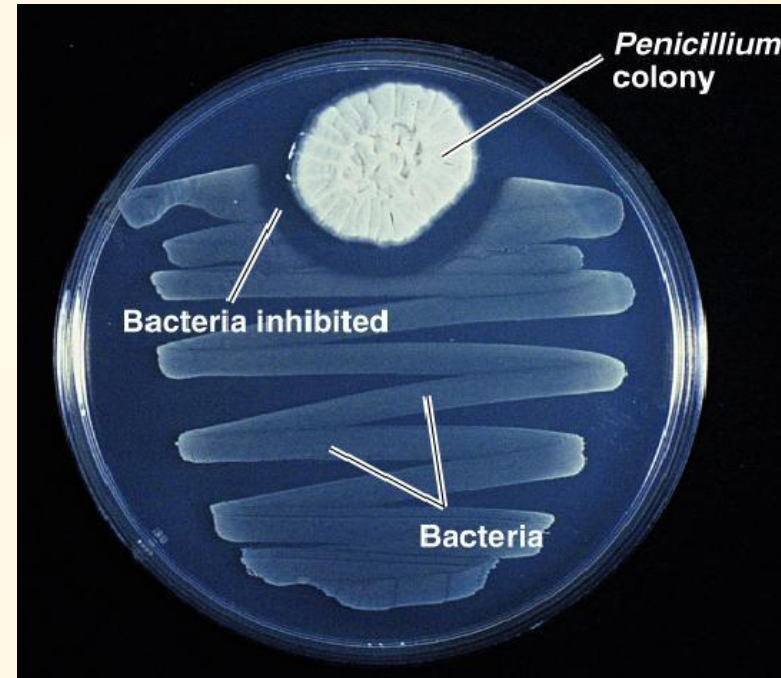


# Chemotherapy

## Remember...

### Antibiotics & Vitamins

- Source of antibiotics
  - Penicillin
    - *Penicillium notatum*
  - Cephalosporin (an antibiotic), cyclosporine (an immunosuppressant) and statins (lower cholesterol) are important drugs derived from fungi.
- Source of vitamins and enzymes.



# The Modern Age of Microbiology

- **What Will the Future Hold?**
  - Microbiology is built on asking and answering questions.
  - The more questions we answer, the more questions we have.