SCOPE AND HISTORY OF MICROBIOLOGY

Objectives

1. Discuss importance of microbes.
2. Distinguish the types of microbes.
3. Correctly name microorganisms.
4. State where microbes are found.
5. Describe the advances that made the study of microbes possible.
6. State the steps used to determine the cause of microbial diseases.

Outline

A. Niches of Microorganisms
B. Types of Microorganisms
    1. Naming Organisms
    2. Classifying Microorganisms
C. Locations of Microorganisms
D. Microbiology becomes a Science
    1. Creation of the Microscope
    2. Development of Aseptic Techniques
    3. Advances in Cultivation Methods
E. Microbes Cause Disease!
    1. Germ Theory of Disease
        a. Koch's Postulates
    2. Chemotherapy
    3. Vaccination

A. Niches of Microorganisms (D)

- Health and Disease

- Agriculture and Food Spoilage

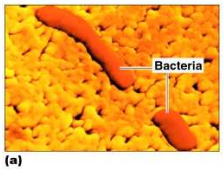
- Industry and Biotechnology

- Basic Research

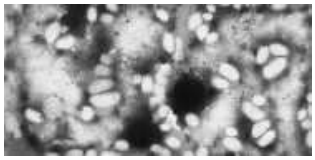
- Environmental Roles

B. Types of Microorganisms (D)

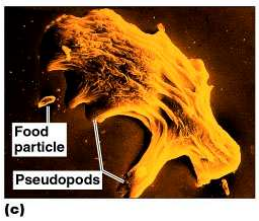
- Bacteria (Monera, Prokaryotae)
  - Bacteria (Eubacteria)



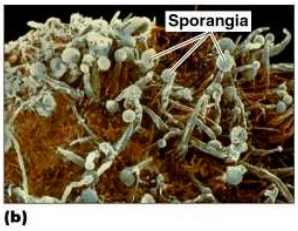
  - Archaea (Archaebacteria)



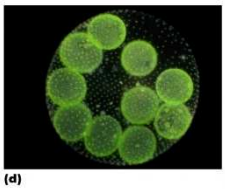
- Protozoa (Protista or many kingdoms)



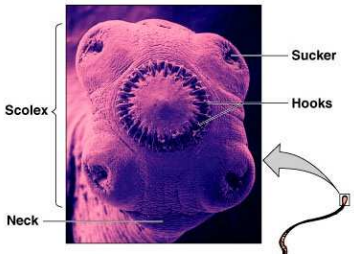
- Fungi (Fungi)



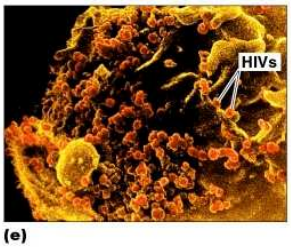
- Algae (Chromalveolata & Archaeplastida)



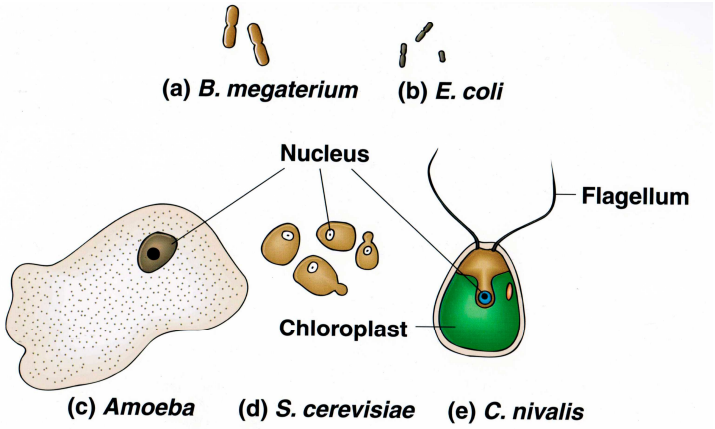
- Microscopic animals (Animalia)



- Viruses



- Viroids and Prions



1. Naming Organisms

- Binomial Nomenclature
  - Genus
  - specific epithet
  - Species

2. Classifying Microorganisms

- Bacteria (Eubacteria)

- Archaea (Archaebacteria)

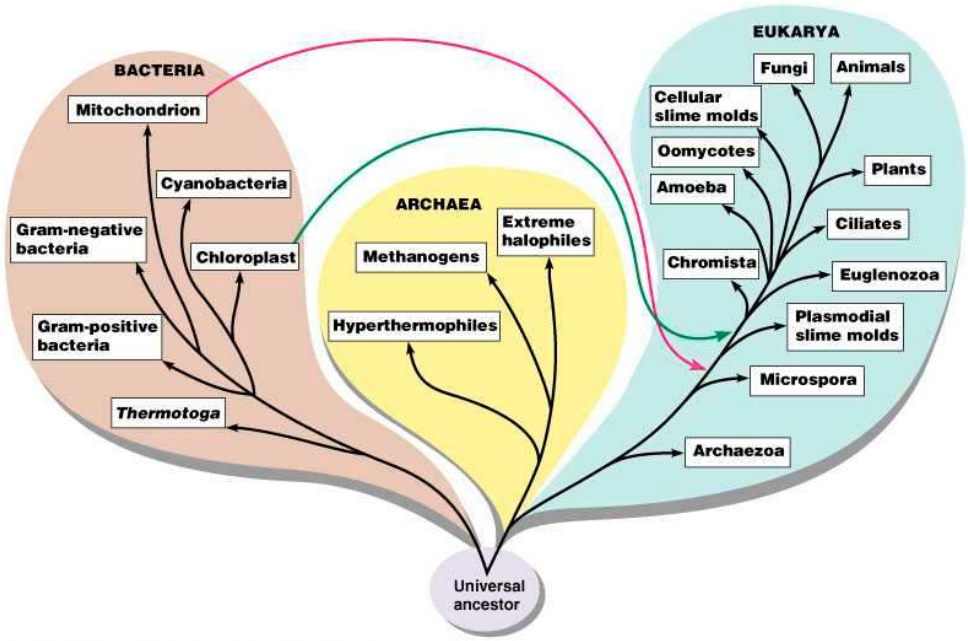
- Eukarya (Eukaryotes)

    - Fungi

    - Protista

        - Chromista

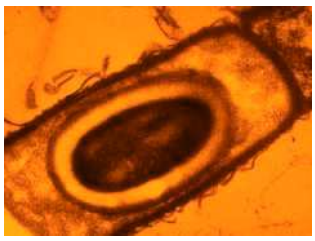
        - Archaeplastida



C. Locations of Microorganisms

- Ubiquitous

- Tolerances
  - Temperature: -10 – 110ºC
  - pH: 0-13
  - below: 5 km of rock
  - below: 4 km of water
  - above: several km from ground
  - dormancy: 15,000 years
    - Survive drying, freezing, boiling



- Grow on and in organisms
  - All exposed surfaces
  - Inside plant stems, leaves, roots
  - Inside animal respiratory, digestive and urogenital systems

- Not found inside healthy cells???

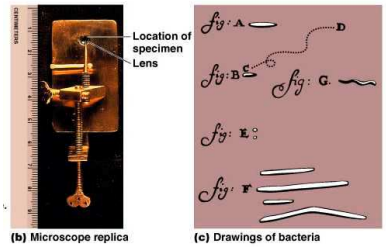
- Never discovered outside of earth

D. Microbiology becomes a Science

- A science only the past 150 years

1. Creation of the Microscope

- Simple Microscope
    - Anton van Leeuwenhoek (1674)
        - first to see bacteria



- Compound Microscope
    - Hans and Zacharias Jensen (1590?)
    - Giovanni Battista Amici (1827)
- Electron Microscope
    - Ernst Ruska (1931)

2. Development of Aseptic Techniques

- Spontaneous generation

- Biogenesis (Rudolph Virchow, 1858)

- Biogenesis of Animals

    - Francesco Redi (1668)

- Biogenesis of Bacteria
    - John Needham (1748) **(D)**

    - Lazarro Spallanzani (1768)

    - Louis Pasteur (1861)

- Biogenesis of Endospores

    - Felix Pouchet (1864)

    - John Tyndall (1881)

3. Advances in Cultivation Methods

- Isolation by Droplet
  - Lazzaro Spallanzani

- Isolation by Streaking
  - Robert Koch

(b)

    - potato slices under bell jar

    - gelatin slabs under bell jar

  - Angelina Hesse
    - agar slabs under bell jar

  - Julius Richard Petri
    - stackable flat dish
      - top larger than bottom

E. Microbes Cause Disease!

1. Germ Theory of Disease

- Varro

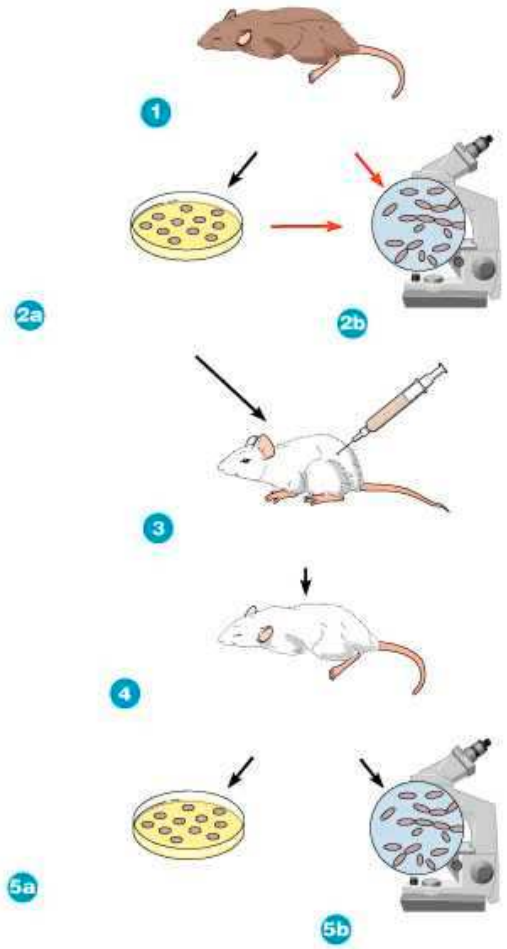
- Circumstantial evidence from Hygiene
  - Ignaz Semmelweis (1847)
    - puerperal (childbed) fever

  - Joseph Lister (1865)
    - antisepsis

- Evidence from Dissection/Isolation
  - Agostino Bassi (1835)
    - Fungus in silkworms

  - Robert Koch (1876)
    - anthrax in sheep

a. Koch's Postulates (D)



1. correlation

2. isolation

3. causation

4. confirmation

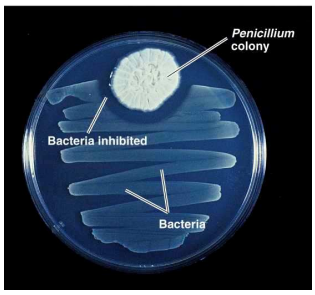
2. Chemotherapy

- Curing of current infections

- Synthetic Drugs
  - Paul Ehrlich (1909)
    - “magic bullet”

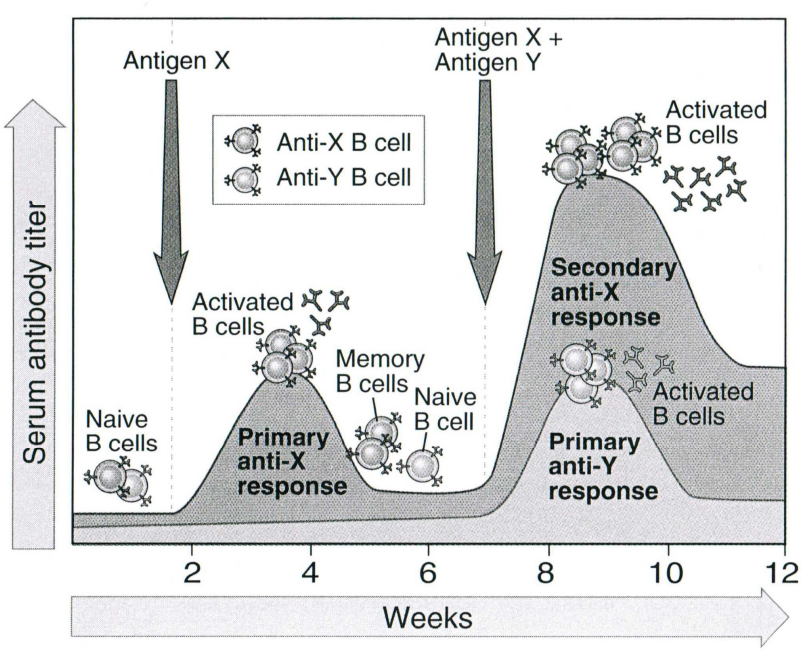
  - Gerhard Domagk (1932)
    - Prontosil

- Antibiotics
  - Alexander Fleming (1928)
    - *Penicillium*



3. Vaccination

- Prevention of Future Infection
    - Introduce antigen into system
    - Lymphocytes produce antibodies
    - Memory cells remain after attack
    - Quicken response to next attack



- Historical
    - Edward Jenner (1796)
        - cowpox to inoculate smallpox
    - Louis Pasteur (1879)

- Types
  - Attenuated whole-agent
  - Inactivated whole agent
  - Subunit
    - Recombinant
  - Toxoid

TABLE 18.1 Principal Vaccines Used in the United States to Prevent Bacterial Diseases in Humans

Disease	Vaccine	Recommendation	Booster
Diphtheria	Purified diphtheria toxoid	See Table 18.3	Every 10 years for adults
Meningococcal meningitis	Purified polysaccharide from *Neisseria meningitidis*	For people with substantial risk of infection	Need not established
Pertussis (whooping cough)	Killed whole or acellular fragments of *Bordetella pertussis*	Children prior to school age; see Table 18.3	For high-risk adults
Pneumococcal pneumonia	Purified polysaccharide from *Streptococcus pneumoniae*	For adults with certain chronic diseases; people over 65; children 2–23 months	

TABLE 18.2 Principal Vaccines Used in the United States to Prevent Viral Diseases in Humans

Disease	Vaccine	Recommendation	Booster
Influenza	Injected vaccine, inactivated virus (nasally administered vaccine with attenuated virus available soon)	For chronically ill people, especially with respiratory diseases, or for healthy people over 65	Annual
Measles	Attenuated virus	For infants age 15 months	See Table 18.3
Mumps	Attenuated virus	For infants age 15 months	(Duration of immunity not known)
Rubella	Attenuated virus	For infants age 15 months; for females of childbearing age who are not pregnant	(Duration of immunity not known)
Chickenpox	Attenuated virus	For infants age 12 months	(Duration of immunity not known)
Poliomyelitis	Attenuated or killed virus (enhanced potency type)	For children, see Table 18.3; for adults, as risk to exposure warrants	(Duration of immunity not known)
Rabies	Killed virus	For field biologists in contact with wildlife in endemic areas; for veterinarians; for people exposed to rabies virus by bites	Every 2 years
Hepatitis B	Antigenic fragments of virus	For children, see Table 18.3; for adults, especially health care workers, homosexual males, injecting drug users, heterosexual people with multiple partners, and household contacts of hepatitis B carriers	Duration of protection at least 7 years; need for boosters uncertain
Hepatitis A	Inactivated virus	Mostly for travel to endemic areas and protecting contacts during outbreaks	Duration of protection estimated at about 10 years