

Introduction to Microbiology

The Microbial World and You

Microorganisms/ Microbes:

- typically unicellular
- too small to see with unaided eye
- Microorganisms are including:
 - Bacteria & archaea
 - Fungi
 - Protozoa
 - Algae
 - Viruses

These microorganisms are:

- located almost everywhere
- only a small % are pathogens
- most involved in environmental / ecosystem balance:
 - *breakdown waste
 - *fix nitrogen
 - *photosynthesis – foundation of food chain
 - *digestion in animals
 - *vitamin production

Organism Nomenclature

- Established by Carolus Linnaeus (1735)
- Latinized
- each organism has unique two parts

Genus and species name: e.g. (*Escherichia coli*)

- written in italics or underlined
- genus with capital first letter
- species/specific epithet all lowercase
- after first use in documents can abbreviate genus: *E. coli*
- name often describes organism: shape, habitat, name of discoverer, etc.

Microbial Groups:

Bacteria

Archaea

Fungi

Protozoa

Algae

Viruses

Brief History of Microbiology

1- Robert Hooke (1665)

- developed first microscope
- observed smallest units of life, calls them **cells**
- proposed cell theory: all living things are composed of cells

2- Antoon Van Leeuwenhoek (1673-1723)

- enhanced microscope magnification
- published observations of tiny live moving objects: called them "**animalcules**"

Scientists now interested in microbes.

Where do they come from?

Prevailing thoughts:

Spontaneous Generation Theory: some forms of life could arise **spontaneously** from nonliving matter

Rudolf Virchow (1858)

- Theory of Biogenesis:** living cells can only arise from living cells

Great debates & Experiments to prove both sides continue

Pasteur (1861)

- demonstrates microbes in air can contaminate sterile solutions but air cannot give rise to microbes: no spontaneous generation
- microbes present on all non-living matter
- microbes can be killed by heat
- methods can block access of microbes to sterilized medium: **aseptic technique**
- sick wine problem: establishes link between activity of a microbe and specific change in organic material.

sugar + yeast = alcohol (wine)

sugar + bacteria = acid (vinegar)

-invented Pasteurization: kill contamination

-applied 'microbes cause change in organics' logic to disease

Germ Theory of Disease.

Microbes cause disease

(prevailing thought: disease = punishment for misdeeds)

Joseph Lister (1860s)

-knew physicians transmitted infections

-knew phenol (carbonic acid) killed bacteria

-treated surgical wounds and implements, reduced incidence of infection

Robert Koch (1876)

-proves Germ Theory of Disease:

*Anthrax-kills livestock

*isolated *Bacillus anthracis* from sick animals

*grows *B. anthracis* in culture

*injects culture into healthy animal

*animal sick with Anthrax, dies, same *B. anthracis* in blood

-Koch's Postulates: experimental steps to

prove a particular bacteria causes a particular disease

(1857-1914) Golden Age of Microbiology

-Establishment of Microbiology as a science

-Discovery of disease agents

-Discovery of role of immunity

-Development of vaccines

-Development of Chemotherapy Vaccination.

Edward Jenner (1796)

-observed milk maids who got cowpox never got smallpox

-injected cowpox into child, child mildly ill

-child never contracted cowpox or smallpox

Louis Pasteur (1880)

- observed bacteria grown in lab became virulent but could produce immunity
- coined the term vaccine (vacca is Latin for cow)

Chemotherapy = treatment of disease using chemicals

Antibiotics = chemicals produced by one microbe to kill another

Synthetic drug = chemicals synthesized in lab to treat infections and disease

Paul Ehrlich (1910)

- first chemotherapy for infection
- Salvarsan (arsenic) for syphilis

Alexander Fleming (1928)

- first antibiotic
- Penicillin for *Staphylococcus* infections

Early microbiology topics now divided into specific fields:

Bacteriology : bacteria & archaea

Mycology : fungi

Phycology: algae

Parasitology: protozoa and parasitic worms

Virology: viruses

Immunology: host immunity & vaccines

Recombinant DNA Technology: insertion of genes into microbes to produce therapeutics.

Microbes and Human Welfare (Good)

- Recycling vital elements (decomposition, photosynthesis, & nitrogen fixation return C, N, O, S, and P back to food chain)
- Sewage treatment
- Bioremediation
- Insect pest control
- Food production
- Commercial applications

-Biotechnology & Genetic Engineering:

- *vaccines
- *therapeutics
- *gene therapy
- *agriculture

Microbes and Human Disease

-**Normal microbiota** (normal flora) = microbes that live on you always sometimes good and sometimes bad

- *prevent pathogen colonization
- *produce vitamins in gut
- *protect mucosal surfaces
- *colonize medical implants
- *typically drug resistant

-Infectious Disease

Pathogens = microbes that have part of life cycle in human host causing illness

- *reemerging and increasing
- *increasing drug resistance

Emerging Infectious Diseases (EIDs) =

diseases that are new or changing and increasing

- *genetic changes in organisms
- *spread to new regions
- *exposure

Of all known bacteria, less than 10% cause any illness in humans