

Introduction to Microbiology

The Microbial World and You

Microorganisms / Microbes:

- typically unicellular
- too small to see with unaided eye
- include:
 - bacteria & archaea fungi
 - protozoa algae viruses
- 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 part **genus**
& **species** name:

e.g. *Escherichia coli*

-written in italics or underlined

-genus with capital first letter

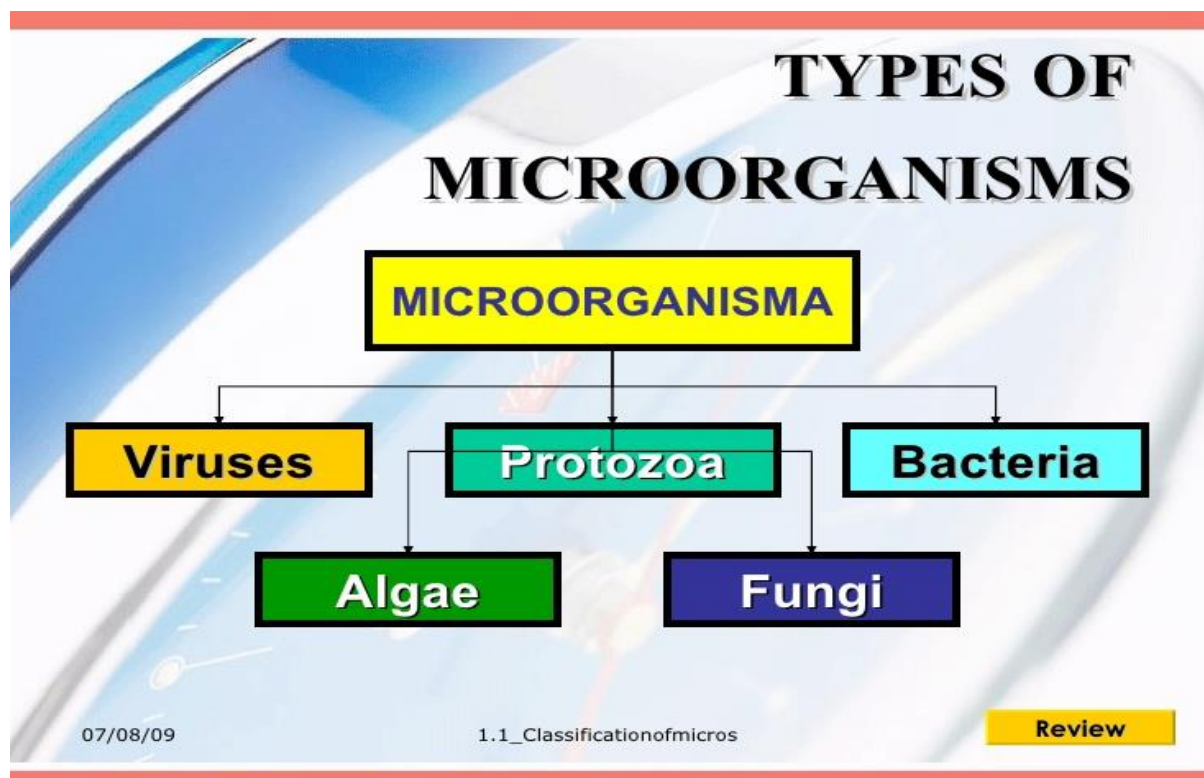
-species/specific epithet all lowercase

-after first use in documents can

abbreviate genus: *E. coli*

-name often describes organism: shape,
habitat, name of discoverer, etc.

Microbial Groups



Brief History of Microbiology

1665 Robert Hooke

- Developed first microscope
- Observed smallest units of life, calls them cells
- Proposed cell theory:

All living things are composed of cells

Prevailing thoughts:

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

1673-1723 van Leeuwenhoek

- Enhanced microscope magnification
- Published observations of tiny live moving objects: called them “animalcules”

Scientists now interested in microbes:

Where do they come from?

1858 Virchow

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

Great debates & Experiments to prove both sides continue

1861 Louis Pasteur

-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

-Establishes link between activity of a microbe and specific change in organic material.

-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)

1860s Joseph Lister

- Knew physicians transmitted infections
- Knew phenol (carbonic acid) killed bacteria
- Treated surgical wounds and implements,
reduced incidence of infection

1876 Robert Koch

- 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:

1796 Jenner lister

- Observed milkmaids who got cowpox never got smallpox
- Injected cowpox into child, child mildly ill
- Child never contracted cowpox or smallpox

1880 Pasteur

- Observed bacteria grown in lab became avirulent 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

1910 Ehrlich

- First chemotherapy for infection
- Salvarsan (arsenic) for syphilis 1928

Flemming

- First antibiotic
- Penicillin for *Staphylococcus* infections

Early microbiology topics now divided into specific fields:

Bacteriology : study of bacteria

Mycology : study of fungi

Phycology: study of algae

Parasitology: study of protozoa
and parasitic worms

Virology: study of 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 and
 - *agriculture

Microbes and Human Disease

-Normal Microbiota = microbes that live in or on you
always

sometimes good, sometimes bad

*prevent pathogen colonization

*produce vitamins in gut

*can cause disease in new location or
immuno-compromised host

-Resistance = ability to ward off disease

-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

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