Introduction to Microbiology
The Microbial World and You
(Chapter 1)
Lecture Materials
for
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Primary Source for figures and content:
Tortora, G.J.  Microbiology An Introduction 8th, 9th, 10th ed.  San Francisco: Pearson
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
(on handout)
Bacteria
Archaea
Fungi

http://www.scienceclarified.com/Ex-Ga/Fungi.html

http://images.agblog.com/workparty/fungi

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SCCC BIO244 Chapter 1 Lecture Slides
Protozoa
Algae
Viruses

Adenovirus 90 nm
Bacteriophages T2, MS2 24 nm
Poliovirus 30 nm
Rhinovirus 30 nm
Bacteriophage T4 225 nm
Tobacco mosaic virus 250 x 18 nm
Vaccinia virus 300 x 200 x 100 nm
Chlamydia elementary body 300 nm
Viroid 300 x 10 nm
E. coli (a bacterium) 3000 x 1000 nm
Rabies virus 170 x 70 nm
EB virus 970 nm

Human red blood cell 10,000 nm in diameter
Plasma membrane of red blood cell 10 nm thick

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Brief History of Microbiology
(on handout)

1665 Hooke
- developed first microscope
- observed smallest units of life, calls them cells
- proposed cell theory:
  all living things are composed of cells

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

1858 Virchow
-Theory of Biogenesis: living cells can only arise from living cells

Great debates & Experiments to prove both sides continue
1861 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

-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)
1860s Lister
- knew physicians transmitted infections
- knew phenol (carbonic acid) killed bacteria
- treated surgical wounds and implements, reduced incidence of infection

1876 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
- 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 Fleming
- 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

(a) The milk has been coagulated by the action of rennin (forming curd) and is Here the wo:

(b) The curd is chopped into small cubes to facilitate efficient draining of whey.

(c) The curd is milled to allow even more drainage of whey and is compressed into blocks for extended ripening. The longer the ripening period, the more acidic (sharper) the cheese.
-Commercial applications

-Biotechnology & Genetic Engineering:
  * vaccines
  * therapeutics
  * gene therapy
  * agriculture

Microbes and Human Disease
- Normal Microbiota = microbes that live 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
-Biofilms = attachment of microbes sometimes good, sometimes bad
  * 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