Introduction to Microbiology

Lecture #1 – Dr. Gary Mumaugh

Subjects Covered

- Microbiology Overview
- Microbiology History
- Microbiology Relevance & Impact
- Germ Theory
- Koch's Postulates
- Cell Theory

Microbiology Overview

- Branch of biology dealing with microorganisms and the effects they have on other organisms
    - Micro – not visible to the naked eye
    - Biology – the study of living things
- Microorganisms are everywhere and play important part in our lives
    - Positive - Composting, fertile soils, recycle nutrients, etc.
    - Negative - Food spoilage, diseases, etc.

Microorganisms are Unicellular

- Composed of a single cell or cell cluster
- Seen with the light microscope
- Microorgansims seen without nucleus called Prokaryotes (*Pro*-before, *cary*-kernal or nucleus)
    - Bacteria and viruses
- Microorganisms seen with a nucleus is called Eukaryotes (*Eu*-true, *cary*-kernal or nucleus)
- Microbial colonies and colonies are easily seen in nature
    - Examples - Fungi, algae, mold, bacterial colonies

Microbiology History

- 1674 Microbiology born as a science
    - Anthony van Leeuwenhoek
        - Dutch drapery merchant
        - Ground lenses to view fabric
        - Used lens to peer into a drop of lake water
            - First glimpses of microbial world
            - Called organisms "animalcules"

The Origin of Microorganisms

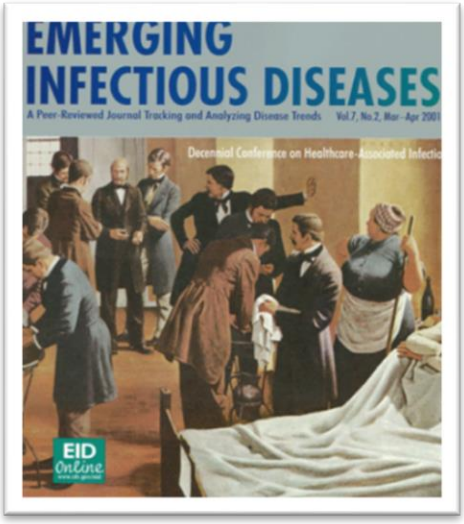
- Theory of Spontaneous Generation
  - Theory states
    - "organisms can arise from non-living matter"
  - Theory had its supporters and detractors
    - Detractors contributed to disproving the theory
      - Francesco Redi
      - Louis Pasteur
      - John Tyndall

Golden Age of Microbiology

- After Theory of Spontaneous Generation was disproved, Golden Age of Microbiology was born
  - Golden Age 1854–1914
    - Time of great interest in the study of microorganisms
    - Between 1875 and 1918 most disease-causing bacteria were discovered
    - Work on viruses began
    - Lead to the initiation of prevention and treatment of disease

Microbiology Timeline

- 1690 - Francesco Redi
  - Italian biologist and physician
  - Demonstrated worms found on rotting meat came from eggs of flies landing on meat
  - Proved this by placing rotting meat in jars
    - Covered one jar with fine gauze
    - Gauze prevented flies from depositing eggs
  - No eggs – no worms
- 1796 Edward Jenner makes first vaccination for small pox
- 1850 Ignaz Semmelweis washing hands as a preventative measure against the spreading of disease
- 1862 - Louis Pasteur
  - Considered the father of modern microbiology
  - Supported the idea of the Germ Theory of Disease
  - Refuted Spontaneous Regeneration
  - Demonstrated that air is filled with microorganisms
    - Proved this by filtering air in cotton plug
- 1867 Joseph Lister experimented and practiced antiseptic surgery
- 1876 Robert Koch discovered Anthrax and was able to provide the first concrete proof of the Germ Theory of Disease
- 1876 Koch began to grow bacteria on solid media
- 1882 Paul Ehrlick developed acid-fast staining



- 1883 Carl Zeiss & Ernst Abbe were pioneers with microscopes and lenses and their immersion techniques are still being used
- 1884 Christian Gram developed Gram Stain
- 1885 Pasteur did first vaccination for rabies
- 1887 R.J. Petri invented “Petri Dish”
- 1892 Dmitri Iosifovick discovered viruses
- 1900 Walter Reed confirmed that mosquitos carried yellow fever
- 1928 Alexander Fleming discovered Penicillin
- 1931 Ernst Ruska makes original electron microscope
- 1977 W. Gilbert & F. Sanger came up with a means for sequencing DNA

Microbiology Relevance & Impact

- Far ranging implications microbiology has had upon medicinal studies, health treatments, revolutionary scientific revelations
- Legal persons utilize DNA to link suspects to a crime
- Medical researchers use microbiology to seek out cures to cancer and other life-altering diseases
- Botanists use it to learn more about endangered plant species
- Microbiology benefits industries such as:
    - Agricultural (infestations)
    - Food & dairy (bacteria)
    - Industrial (petroleum)
    - Medical & healthcare (immunology-parasites-viruses)
- Only 1% all of the microbes have actually been discovered in more than three hundred years
- Microbiology is still in its infancy as compared to many of the other biological disciplines, e.g., botany, entomology and zoology

Branches of Microbiology

- Mycology (study of fungi)
- Virology
- Medical microbiology
- Immunology
- Public health

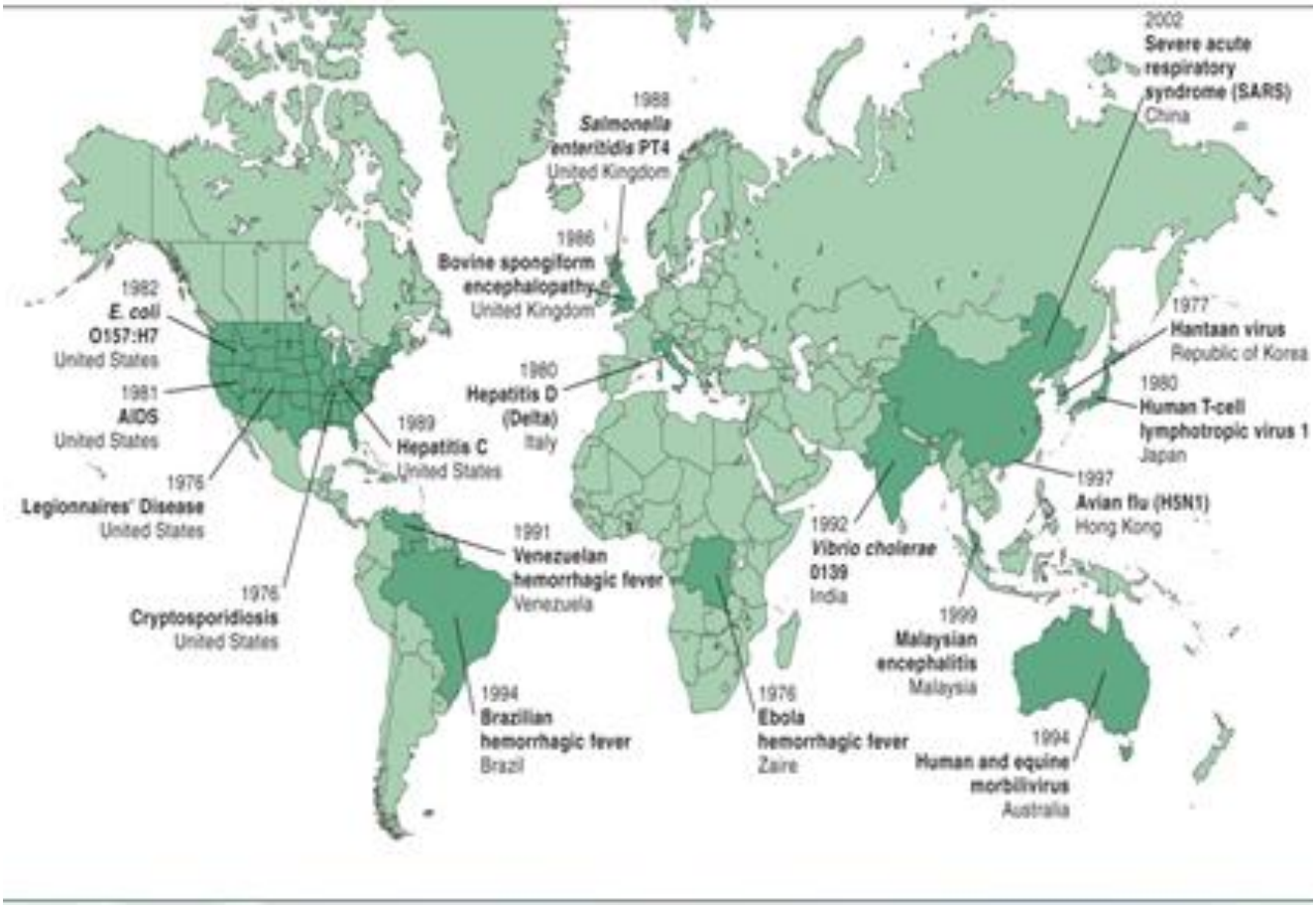
- Water microbiology
- Agricultural microbiology
- Food microbiology
- Biotechnology
- Microbial genetics
- Cell and molecular biology
- Environmental microbiology

Medical Microbiology

- Bacteria do cause disease
    - More people died worldwide of influenza in the 1918 epidemic than died in WWI, WWII, Korean War and Vietnam combined
    - Modern sanitation, vaccination and effective antimicrobial treatments have reduced incidences of the worst diseases

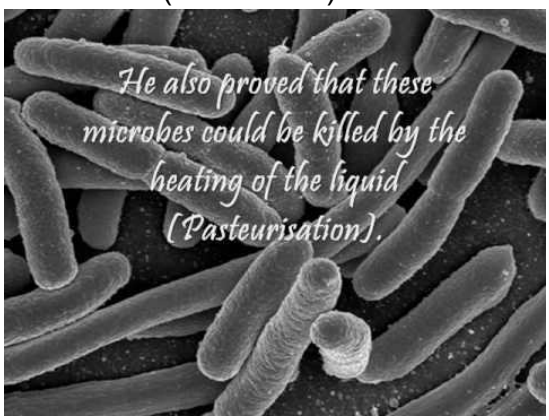
Present and Future Challenges

- Infectious diseases remains a threat
    - 750 million cases each year in United States
        - Resulting in 200,000 deaths
        - Costing tens of billions of dollars spent



Germ Theory

- AKA pathogenic theory of disease
- Considered one of the most important medical discoveries in history
- Proposed that the most infectious of all diseases are caused by germs
- Although highly controversial when first proposed, germ theory was validated in the late 19th century
- Served as the foundation for microbiology, as well as, the touchstone of modern medicine
- Louis Pasteur (1822-1895)



- Robert Koch (1843-1910)
    - Building upon Pasteur's Germ Theory, was the first to cultivate anthrax bacteria outside
    - The purpose of this laboratory test was to learn the extent to which microorganisms contributed to diseases

Koch's Postulates

- An organism can be isolated from a host suffering from the disease and
- The organism can be cultured in the laboratory and
- The organism causes the same disease when introduced into another host and
- The organism can be re-isolated from that host then
- The organism is the cause of the disease and the disease is an infectious disease.

Koch's Postulates

- Koch's ideas eventually led to the development of pure culture techniques and the emergence of agar, Petri dishes, and stains.

Cell Theory

1. Every living organism is made of one or more cells.
2. The cell is the basic unit of structure and function. It is the smallest unit that can perform life functions.
3. All cells arise from pre-existing cells.