

# General Microbiology

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# What is microbiology?

- The science of microorganisms
- Microbes or microorganisms are minute living things that are usually unable to be viewed with the naked eye
- Examples include: Bacteria, fungi, protozoan, algae and viruses
- Some are pathogenic

# Historical Development

- Antony Van Leeuwenhoek (1632-1723)
- Inventor of the first microscope
- His microscope could magnify around 50 to 300 times

# Spontaneous generation

- John Needham: an English scientist theorized that life comes from non life demonstrated by maggots developing on a piece of rotten meat
- Fracastorius Redi: demonstrated that maggot does not evolve from nonliving material by keeping housefly away from rotten meat
- Theodor Schwann: helped developed the cell theory of living organism, namely that all living organisms are composed of one or more cells and that cell is the basic functional unit of living organism

# Development of sterilization and aseptic technique

- **Pasteur** demonstrated that microorganisms in the air were responsible for food spoilage  
Constructed a swan-necked flask



# Koch's postulate

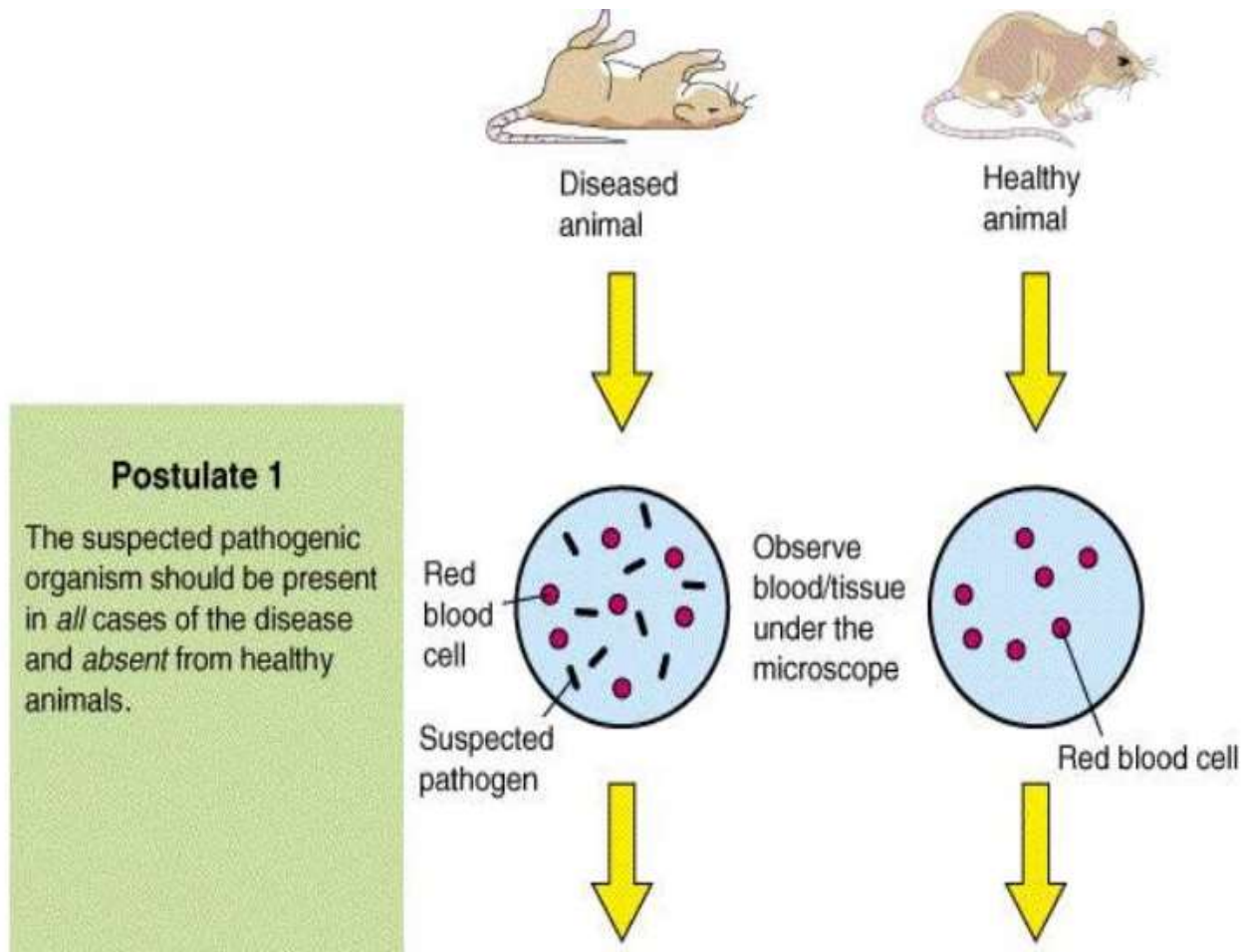
## Germ Theory of Disease

### KOCH'S CONTRIBUTIONS

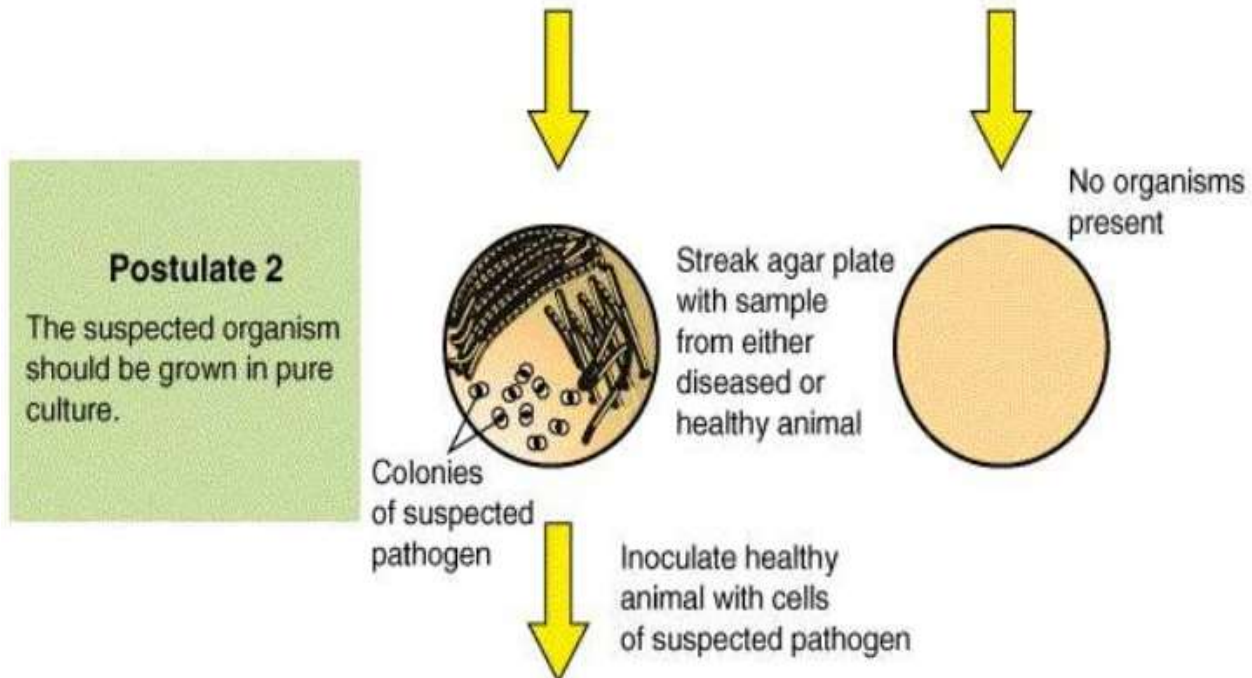


➤ Koch developed four postulates that aided in the definitive establishment of the germ theory of disease. Koch's Postulates are follows:

# Postulate 1



# Postulate 2

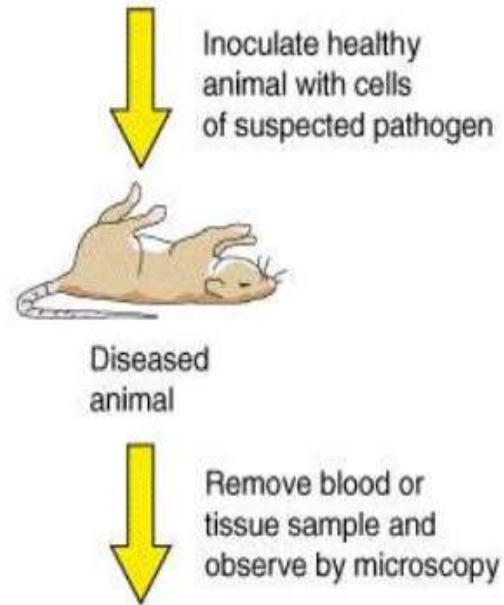




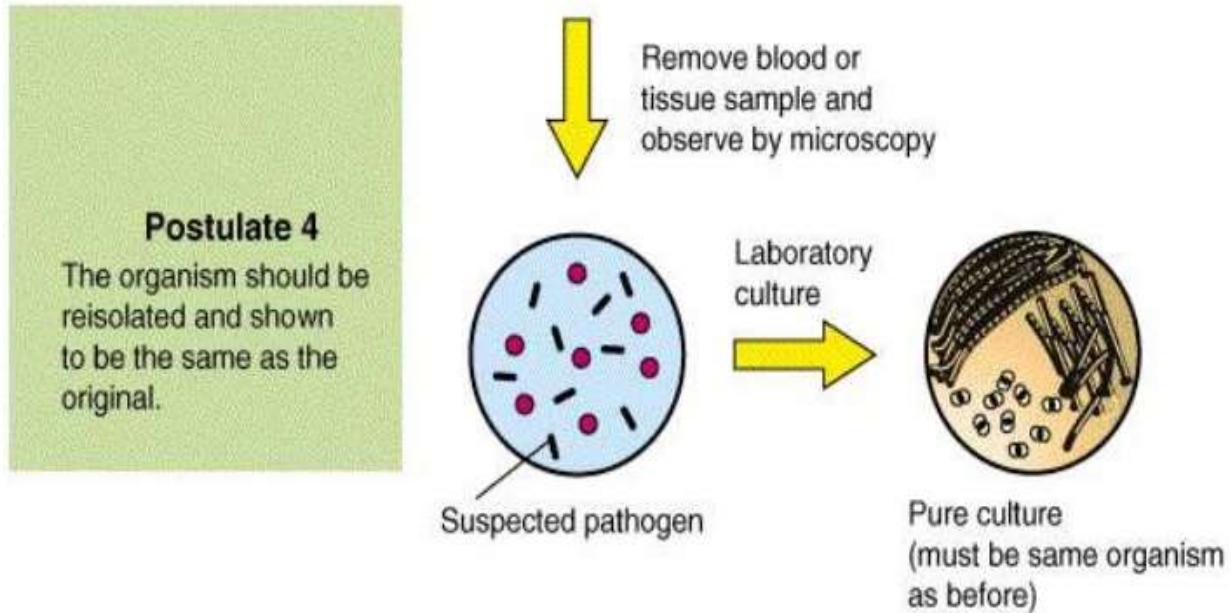
# Postulate 3

## Postulate 3

Cells from a pure culture of the suspected organism should cause disease in a healthy animal.



# Postulate 4



# Chemotherapy

- 1850: Joseph Lister used a chemical disinfectant to prevent surgical wound infection after looking at Pasteur's work showing that microbes are in the air and can spoil food and cause animal diseases
- 1796: Edward Jenner inoculated a person with cowpox virus. The person was then protected from smallpox. The protection is called immunity.

# Chemotherapy

- Chemotherapeutic agents used to treat infectious disease can be synthetic drugs or antibiotics
- Antibiotics are chemicals produced by bacteria and fungi that inhibit or kill other microbes
- Quinine from tree bark was long used to treat malaria
- 1928: Fleming discovered the first antibiotic; penicillin.
- Discovery not accidental but serendipitous

# Chemotherapy

- Paradols, shogaols and gingerols which are phenolic compounds isolated from *Aframomum melegueta* have been shown to possess antimicrobial properties
- Different immunomodulating agents from natural sources have also been shown to activate macrophages and neutrophils

# Agar

- Angelim Hesse
- Development of Agar used to grow microorganism

# Isolation of important Bacteria in the late 19<sup>th</sup> Century

- 1882: Tubercule bacillus (Koch)
- 1883: Cholera vibrio (Kock)
- 1883: Diphtheria bacillus (Klebs)
- 1884: Escherichia coli (Escherichia)
- 1886: Pneumococcus (Francel)
- 1887: Menigococcus (Weichselbauw)
- 1888: Diphtheria toxin (Roux and Yesin)

# Isolation of important bacteria in the late 19<sup>th</sup> Century

- 1889: Tetanus ( Kitasato)
- 1889: Tetanus toxin ( Kitasato)
- 1894: Plague bacillus ( Kitasato and Yersin independently)



# Prokaryotes and Eukaryotes

1884: Gram- Gram Staining technique

1887: Petri- Petridish

Microorganisms are either prokaryotes or  
eukaryotes

# Prokaryotes

- Distinct nucleus is absent
- DNA is in the form of single circular chromosome
- Rigid cell wall known as peptidoglycan

# Eukaryotes

- DNA is carried on several chromosomes within a nucleus
- Nucleus bound by nuclear membrane
- Cytoplasm rich in membrane bound organelle

# Nomenclature

## Nomenclature

- Scientific Nomenclature
  - System devised by Linnaeus
    - Genus and species
      - Both italicized or underlined
      - Genus name Upper-case; species lower-case
  - Name describes the organism
    - Ex. *Staphylococcus aureus*
      - Staphylococcus: cluster of spheres
      - aureus: golden aura of colonies
  - Name honors the scientist
    - Ex. *Escherichia coli*
      - Escherich: honors the discoverer, Theodor Escherich
      - coli- describes the habitat – the colon or the small intestine

# Three Domains of Life

## Three Domains of Life

- Archaea
  - prokaryotes
  - Primarily extremophiles
  - Not disease-causing
- **Bacteria**
  - prokaryotes
- Eukarya
  - Nucleated organisms
  - Uni- or multi-cellular
  - Fungi
  - Protista
  - Plants
  - Animals

# Classification of Microbes

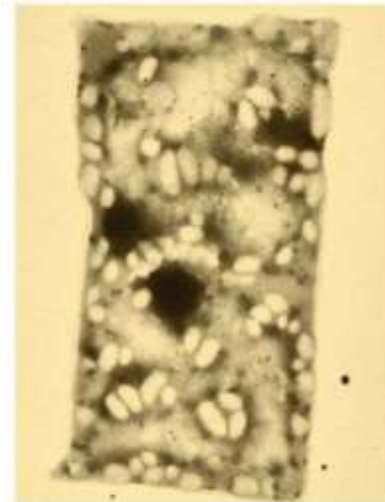
## Classification of Microbes

- Archaea
- Bacteria
- Fungi
- Algae
- Protozoa
- Multicellular Animal Parasites
- Viruses

# Archaea

## Archaea

- Prokaryotes
- No peptidoglycan in cell wall
- Habitat
  - Extreme environments
    - Methanogens (methane)
    - Halophiles (salt)
    - Thermophiles (heat)
- Not known to cause disease in humans



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# Bacteria

## Bacteria

- Prokaryotes
- Cell structure
  - Bacillus, Coccus, Spiral
- Cell wall
  - Peptidoglycan
- Cell Division
  - Binary Fission
- Metabolism: Energy source
  - Inorganic/ organic chemicals
  - Photosynthesis





# Fungi

- Eukaryotes
- Chitin cell walls
- Energy Source:
  - Organic matter
- Multicellular
  - Molds and mushrooms
- Unicellular
  - Yeasts



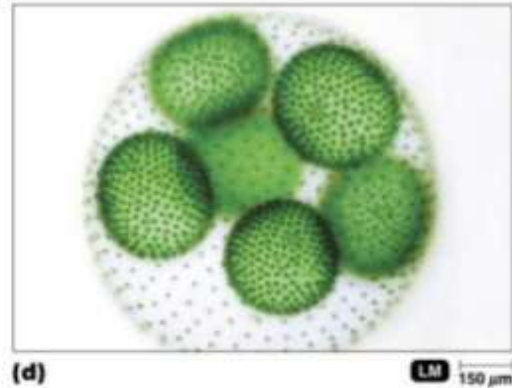
# Protozoa

- Eukaryotes
- Unicellular
- Motile
  - Pseudopodia
  - Cilia
  - Flagella
- Shape
  - Variety of shapes
- Habitat
  - free entities or parasites
- Energy source
  - organic compounds



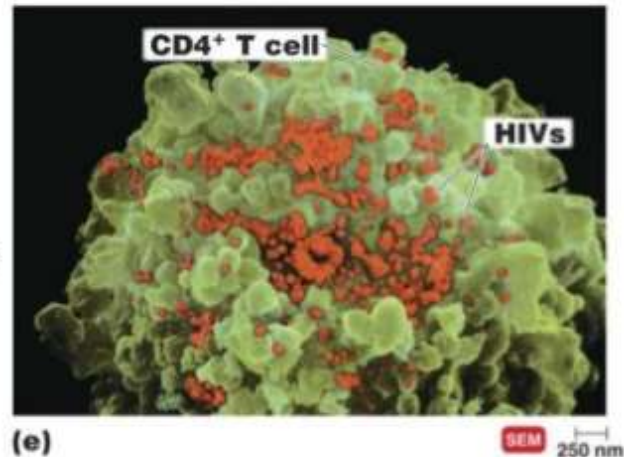
## Algae

- Eukaryotes
- Cellulose cell walls
- Energy source
  - Photosynthesis
- Produce molecular oxygen and organic compounds



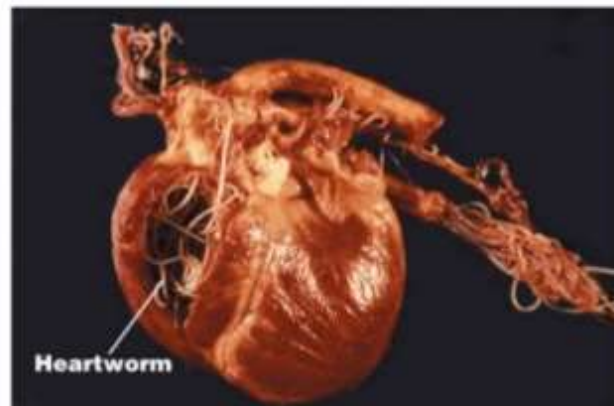
# Viruses

- Neither eukaryote or prokaryote
- Acellular
- Obligate Intracellular Parasites
  - Only replicate when present in living host cell
- Genetic Material
  - Either DNA or RNA
- Structure
  - Nucleocapsid
    - Nucleic acid core
    - Protein coat surrounds core
  - Lipid Envelope
    - Not always present



# Multicellular Animal Parasites

- Eukaryotes
- Multicellular
- Parasitic flatworms and roundworms.



9 mm

# Microbiology issues not too long ago

- 1995- Invasive group A Streptococcus: flesh eating bacteria
- 1995- Ebola hemorrhagic Fever: 75% mortality
- 1999- West Nile Encephalitis: 3559 cases in 35 States of US
- 1996- Bovine spongiform encephalopathy: Mad cow disease
- 1996- E coli O157:H7: 2000 cases in Japan
- 2002- Creutzfeldt Jakob Disease: caused by prion in bovine; UK 138 cases in human

# Microbiology issues not too long ago

- SARS
- H1n1,H5N1- New Bird Flu strains
- 2009- Influenza A /H1N1: 4 Viral strands-2 bovine, 1 avian, 1 human
- Variant strain of old influenza virus that killed 25 million in Europe; originated from Mexico
- Ebola 2014- Has of today killed close to 1500 people in West Africa. No handshake, no sex

# Microscopy -types

- Simple
- Compound
- Phase contrast
- Ultraviolet
- X-ray
- TEM/SEM





# Microbiology issues making news

- 2014- US; Middle East respiratory Syndrome- Americans infected with a mysterious virus that has sickened hundreds in the Middle East. Thank goodness as mortality rate is low
- HIV/AIDS; a global ravaging infection
- Ebola virus 2014-No vaccine

# Microbiology News

- A team of Scientists from the University of Arizona announced recently that human eye using a microscope can be more accurate than automation when it comes to analyzing urine samples for signs of kidney damage.
- What more news can you add?

