HISTORY OF MICROBIOLOGY

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MICROBIOLOGY

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Microbiology

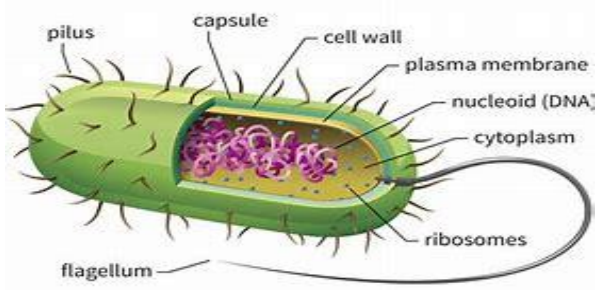
- The development of microbiology as a scientific discipline has depended on the availability of the microscope and the ability to isolate and grow pure cultures of microorganisms
- The development of these techniques in large part grew out of studies
- disproving the Theory of Spontaneous Generation
- establishing that microorganisms can cause disease

Microbiology Definition

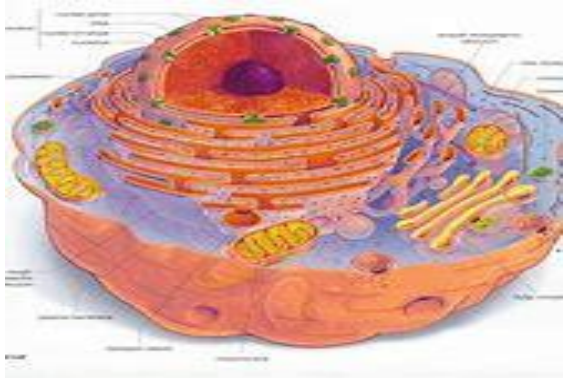
- Microbiology often has been defined as the study of organisms and agents too small to be seen clearly by the unaided eye—that is, the study of microorganisms

Thiomargarita and Epulopiscium are the two bacteria which can be seen by naked eye

- Prokaryotic cells [Greek pro, before, and karyon, nut or kernel; organisms with a primordial nucleus] have a much simpler morphology than eukaryotic cells
- Lack a true membrane-delimited nucleus

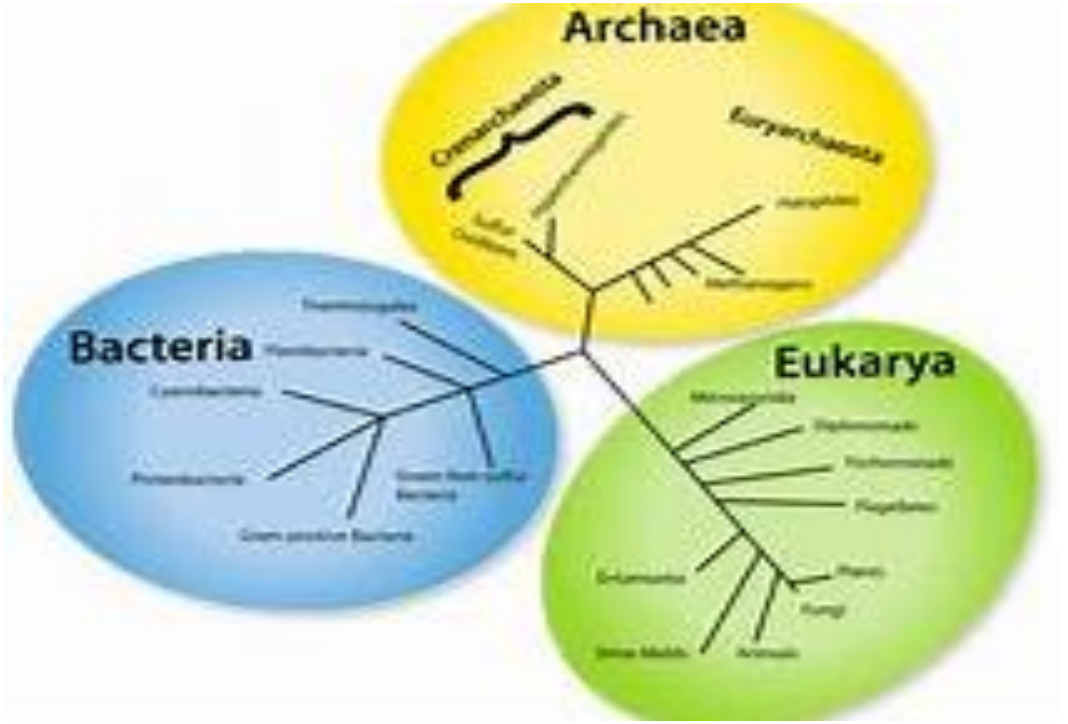


- In contrast, eucaryotic cells [Greek, eu, true, and karyon, nut or kernel] have a membrane-enclosed nucleus
- They are more complex morphologically and are usually larger than prokaryotes



THREE DOMAINS OF LIFE

- Carl Wooese in 1970
- Based on the difference in Ribosomal RNA (rRNA) sequence



3 domains of life

Bacteria

- Bacteria are procaryotes
- usually single-celled organisms.
- Most have cell walls that contain the structural molecule peptidoglycan
- They are abundant in soil, water, and air and are also major inhabitants of our skin, mouth, and intestines.
- Some bacteria live in environments that have extreme temperatures,

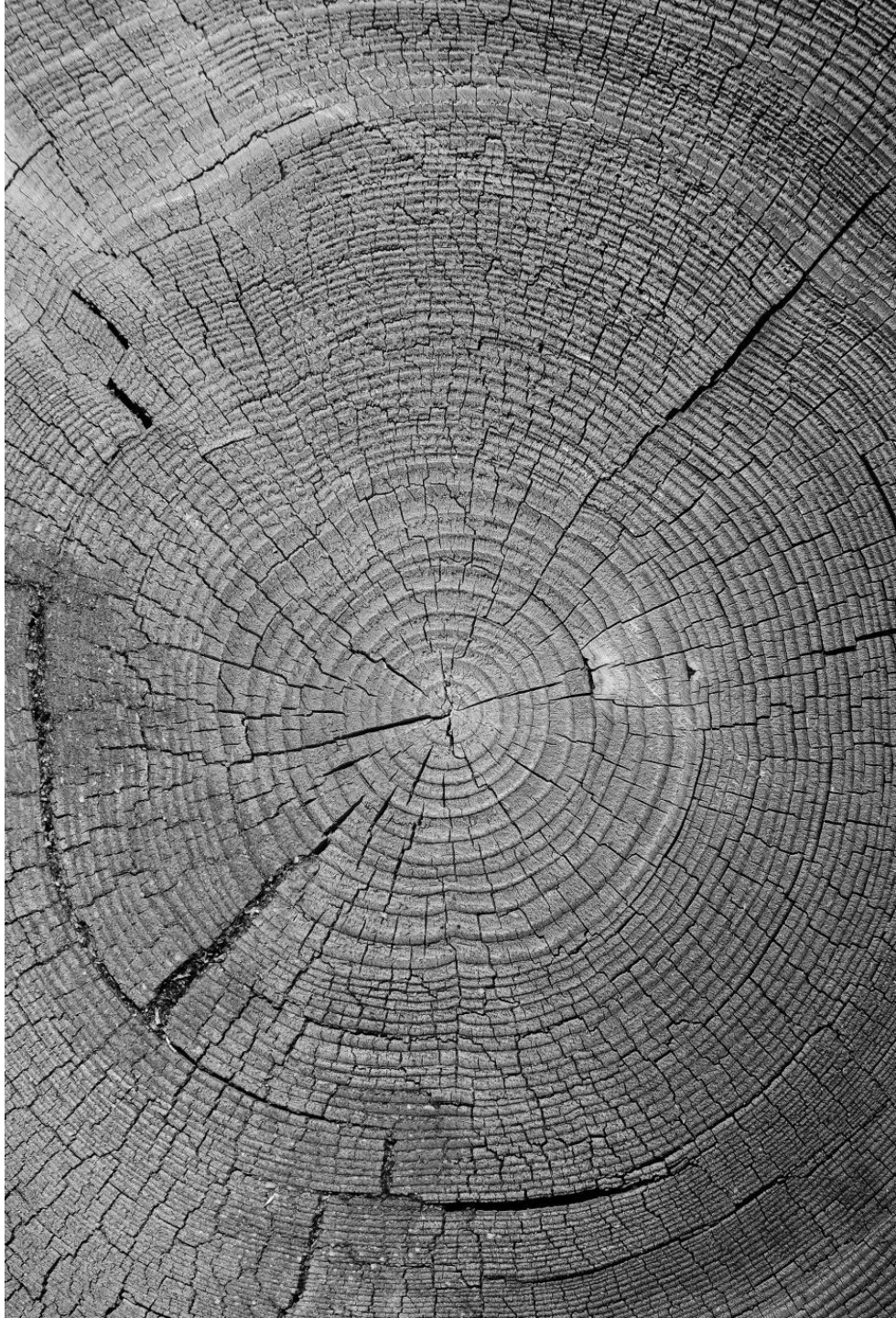
Archae

- Archaea are procaryotes
- most notably their unique ribosomal RNA sequences.
- They also lack peptidoglycan in their cell walls
- Have unique membrane lipids
- Some have unusual metabolic characteristics, such as the methanogens, which generate methane gas. Many archaea are found in extreme environments. Pathogenic archaea have not yet been identified

Eukarya

- Domain Eukarya includes microorganisms classified as protists or Fungi.
- Protists are generally larger than procaryotes and include uni cellular algae, protozoa, slime molds, and water molds.
- Algae are photosynthetic protists that together with the cyanobacteria produce about 75% of the planet's oxygen

History of microbiology



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Theories of spontaneous generations

- Spontaneous generation—that living organisms could develop from non living matter.
- Even Aristotle (384–322 B.C.) thought some of the simpler invertebrates could arise by spontaneous generation.
- This view finally was challenged by the Italian physician Francesco Redi (1626–1697), who carried out a series of experiments on decaying meat and its ability to produce maggots spontaneously
- English priest John Needham (1713–1781) reported the results of his experiments on spontaneous generation.
- Lazzaro Spallanzani (1729–1799) improved on Needham's experimental design by first sealing glass flasks that contained water and seeds. If the sealed flasks were placed in boiling water for 3/4 of an hour, no growth took place as long as the flasks remained sealed

Theories of spontaneous generation

- Theodore Schwann (1810–1882) allowed air to enter a flask containing a sterile nutrient solution after the air had passed through a red-hot tube. The flask remained sterile.
- Georg Friedrich Schroder and Theodor von Dusch allowed air to enter a flask of heat-sterilized medium after it had passed through sterile cotton wool.
- No growth occurred in the medium even though the air had not been heated.

Swan neck flask experiments- Louis Pasteur

- Pasteur , first filtered air through cotton and found that objects resembling plant spores had been trapped.
- If a piece of the cotton was placed in sterile medium after air had been filtered through it, microbial growth occurred. Next he placed nutrient solutions in flasks, heated their necks in a flame, and drew them out into a variety of curves, while keeping the ends of the necks open to the atmosphere
- The English physicist John Tyndall (1820–1893) dealt a final blow to spontaneous generation in 1877
- Ferdinand Cohn (1828–1898) discovered the existence of heat-resistant bacterial endospores

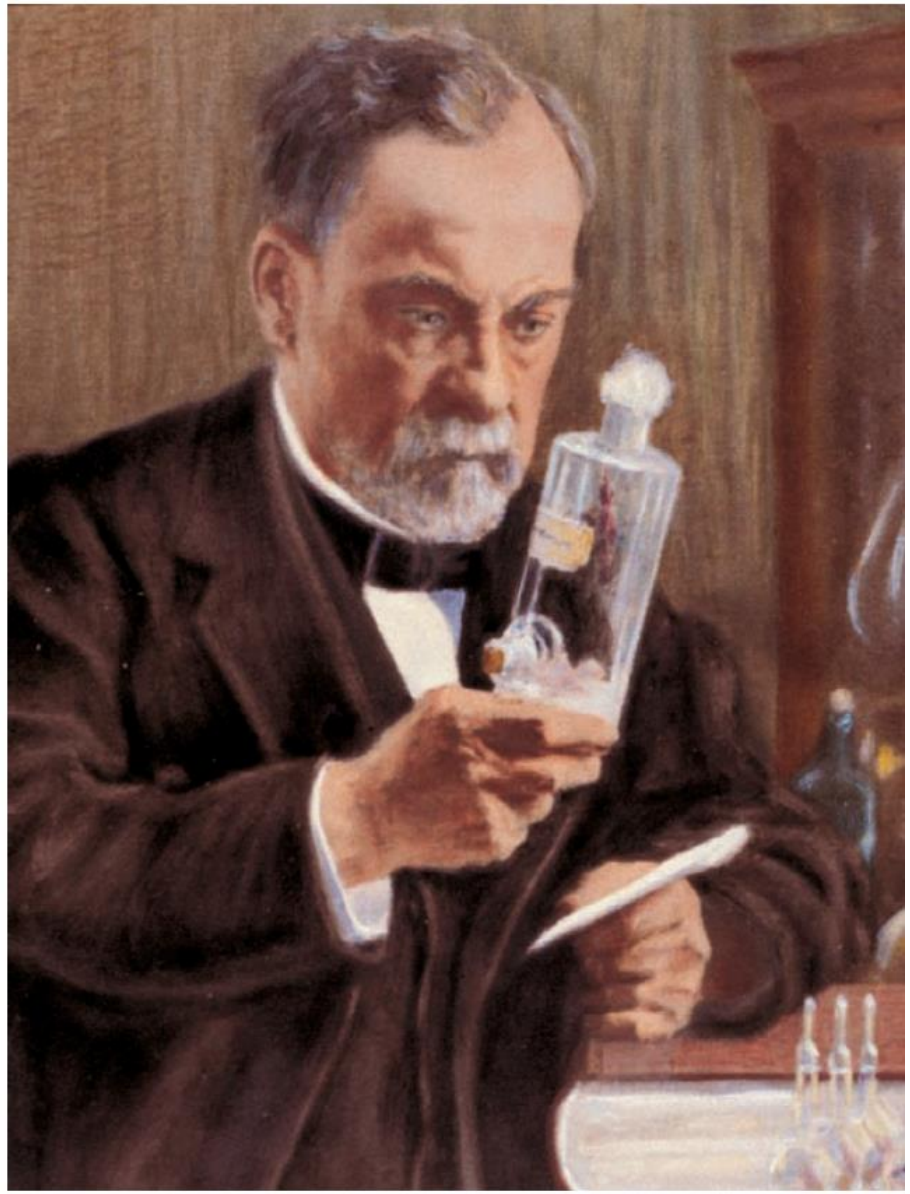


Figure 1.4 Louis Pasteur. Pasteur (1822–1895) working in his laboratory.

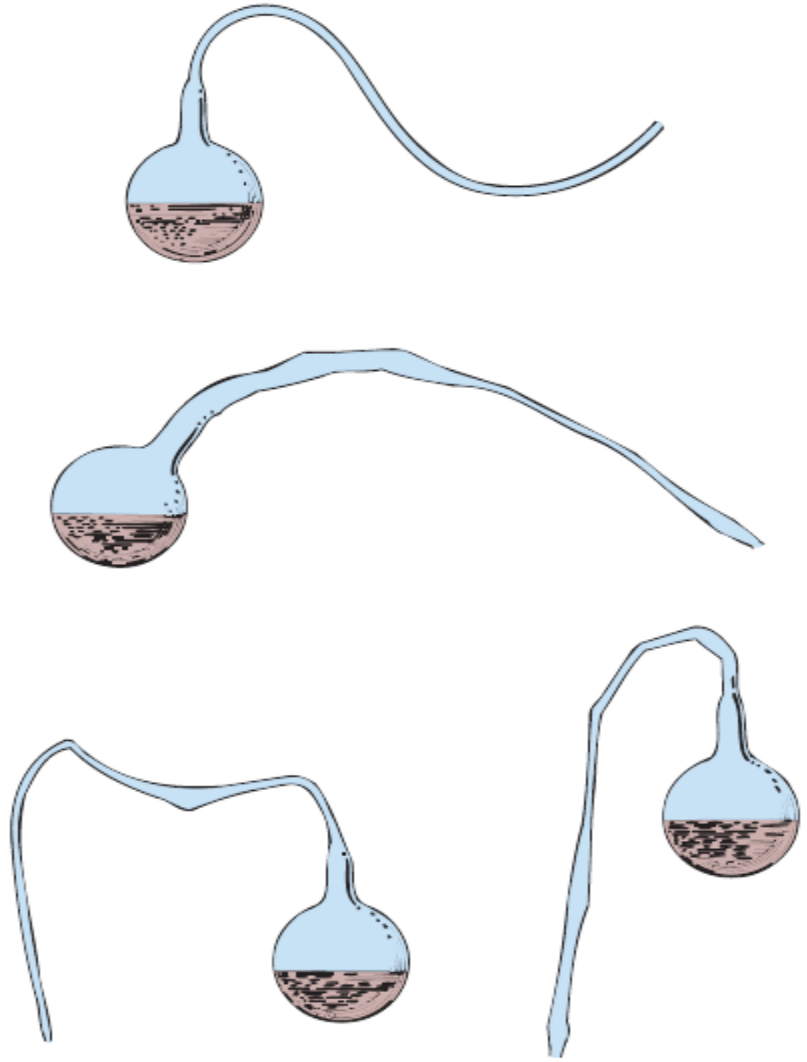
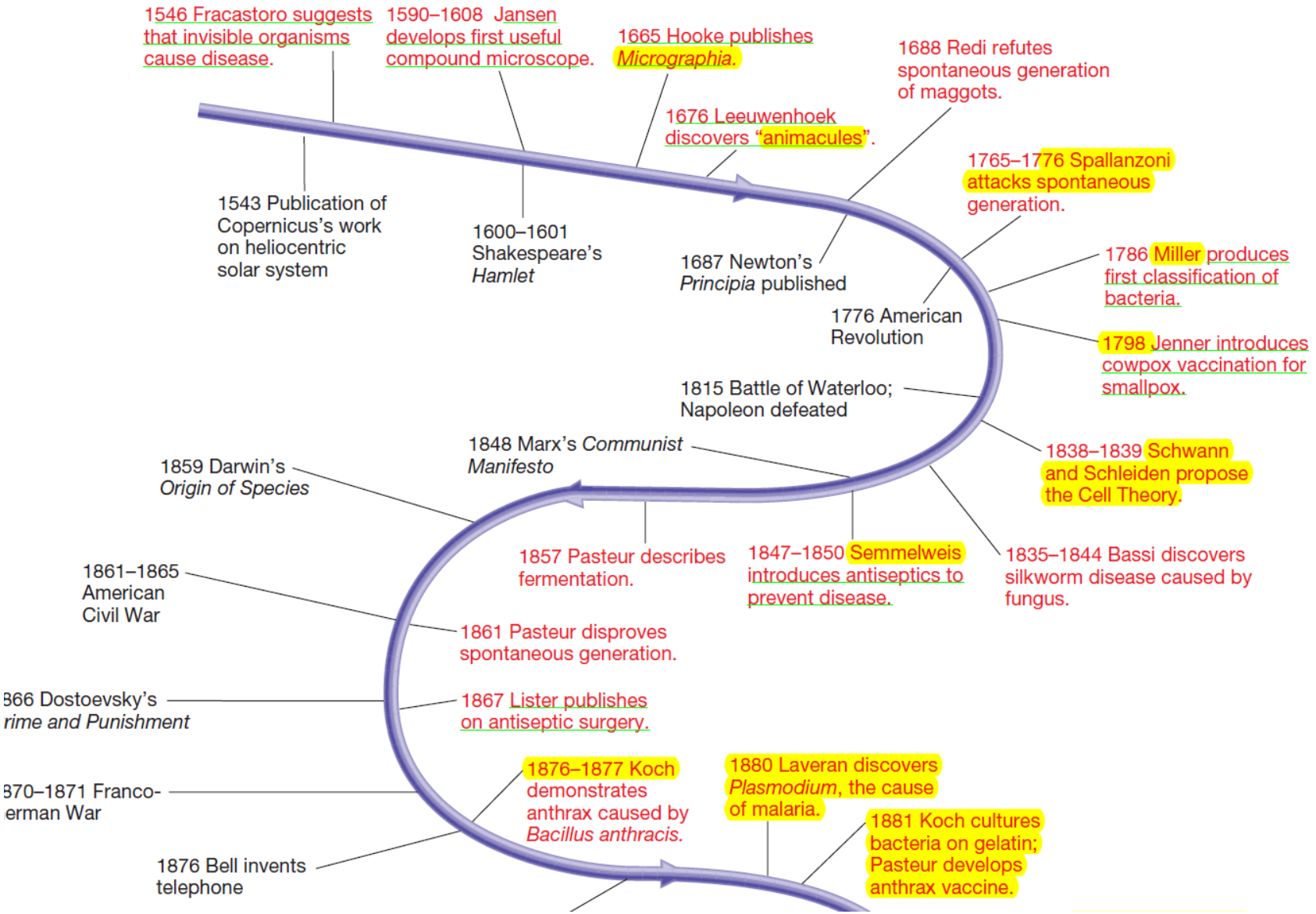
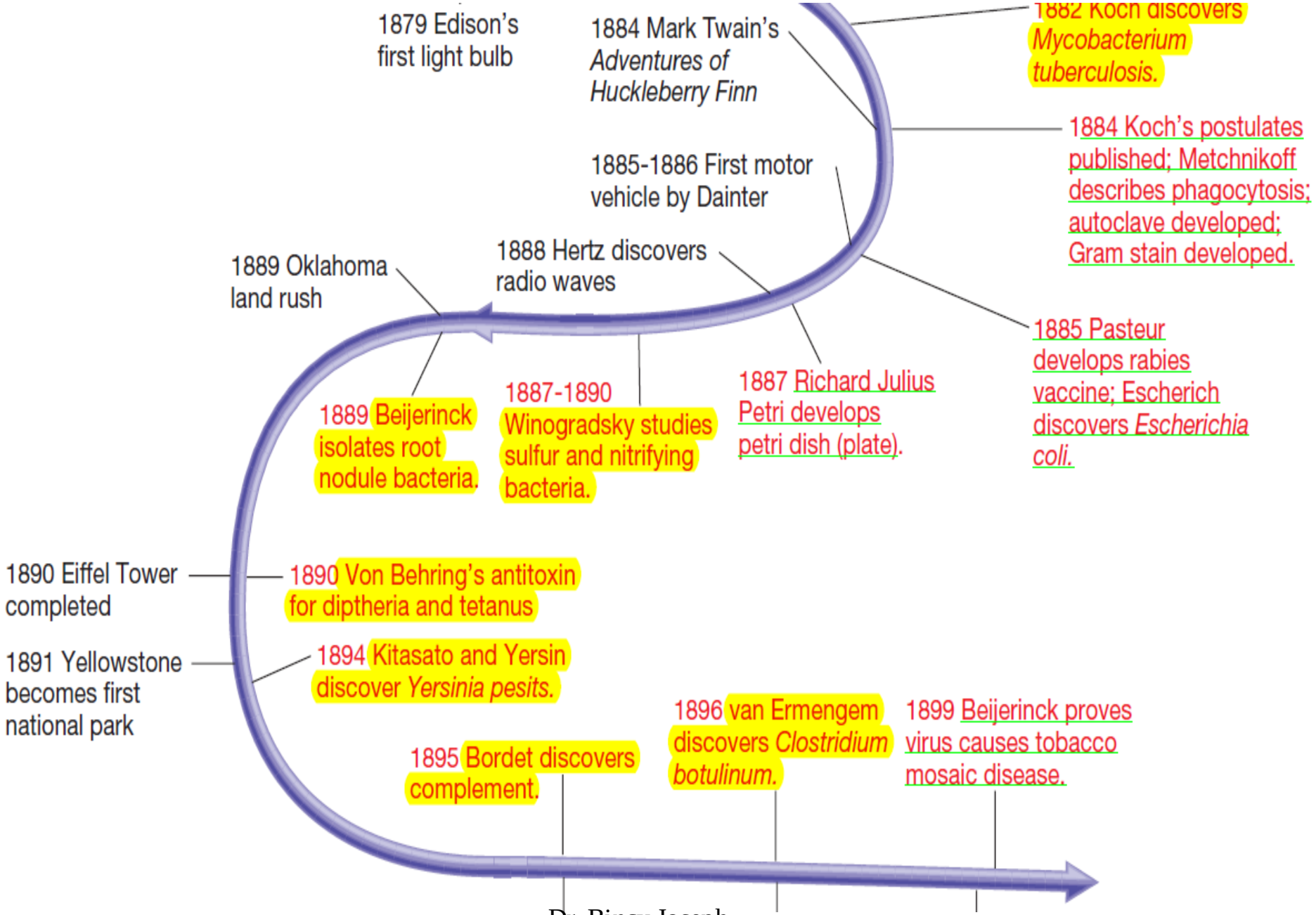


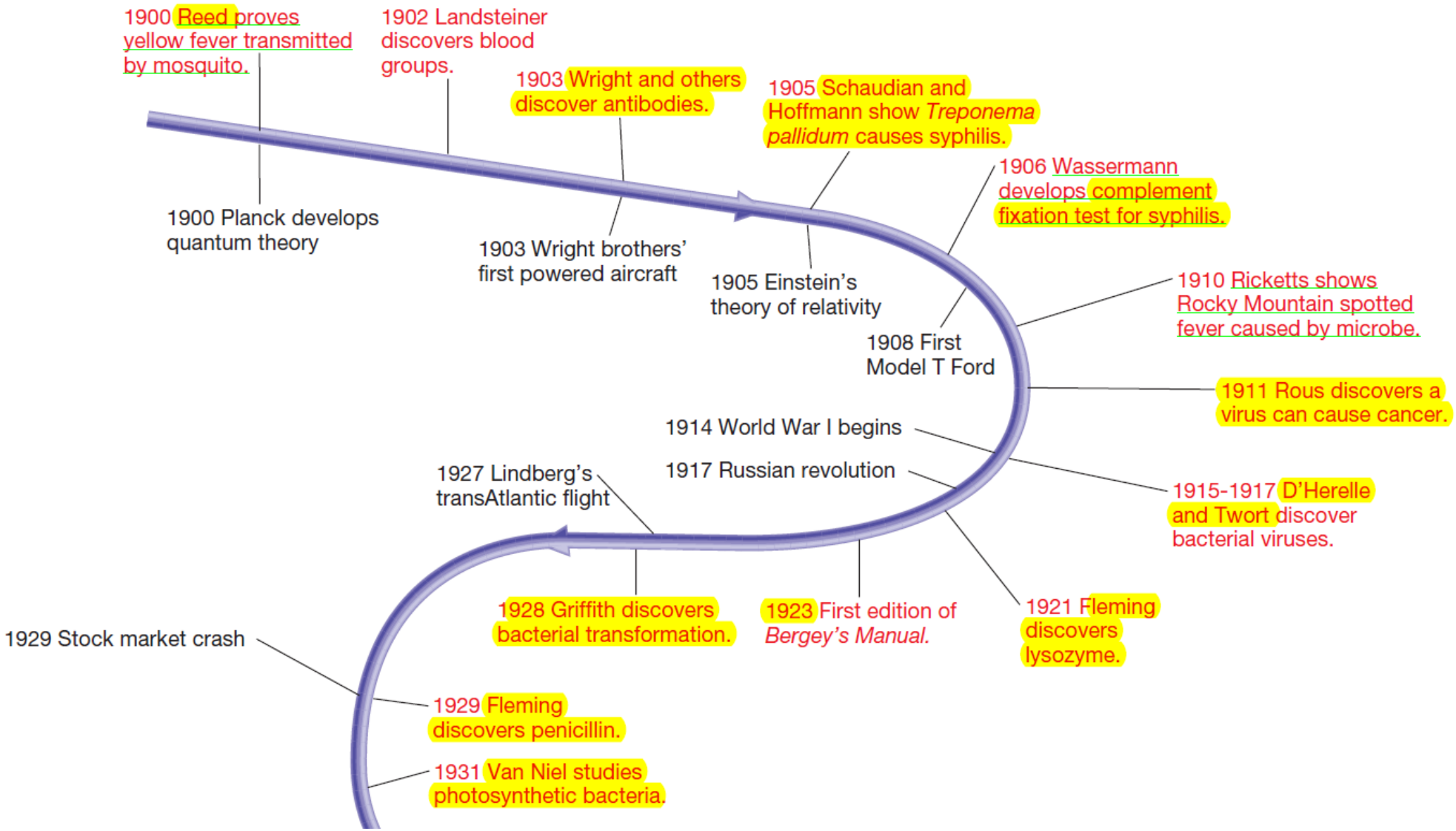
Figure 1.5 The Spontaneous Generation Experiment.
Pasteur's swan neck flasks used in his experiments on the spontaneous generation of microorganisms. *Source: Annales*

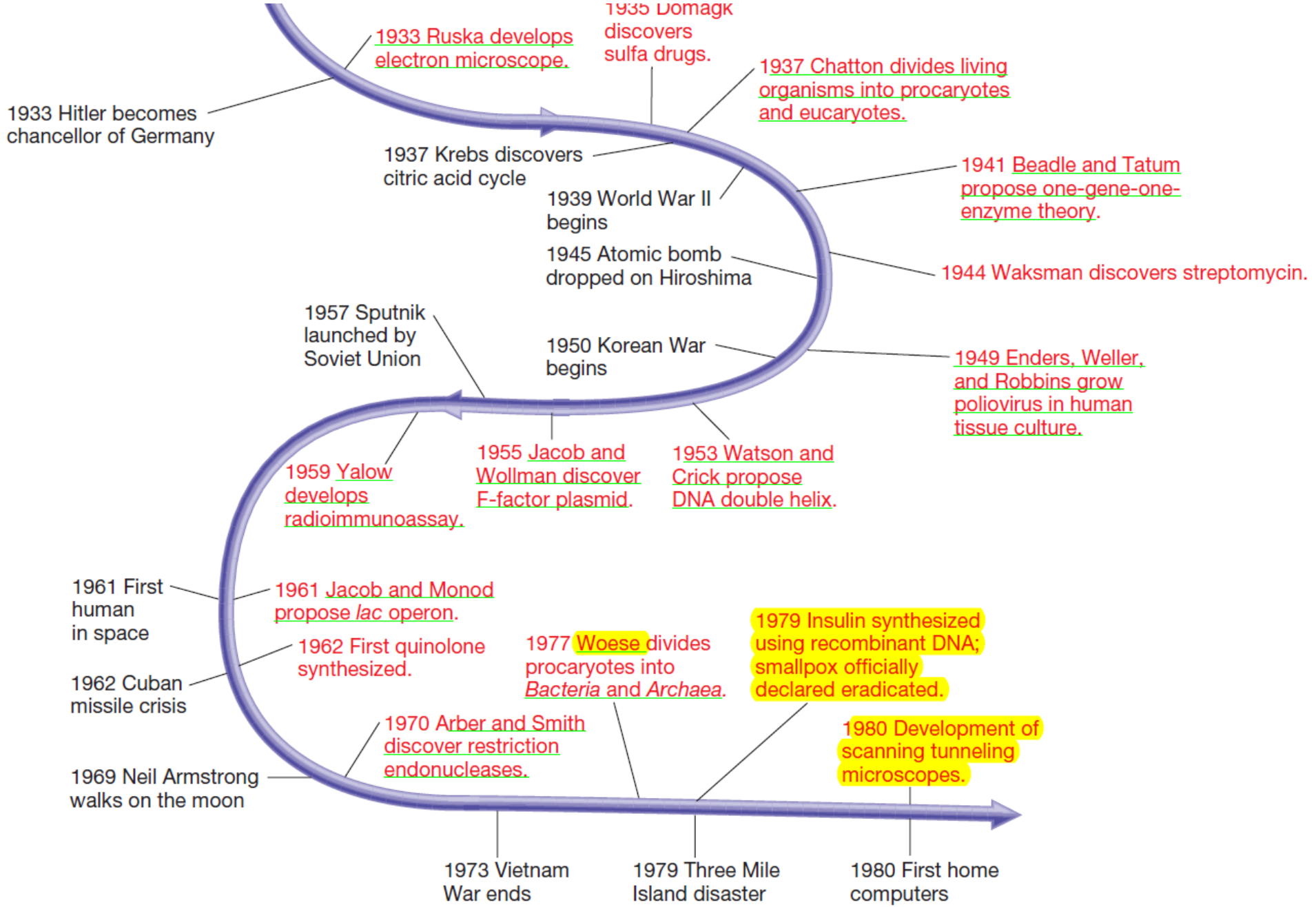
The golden age of microbiology

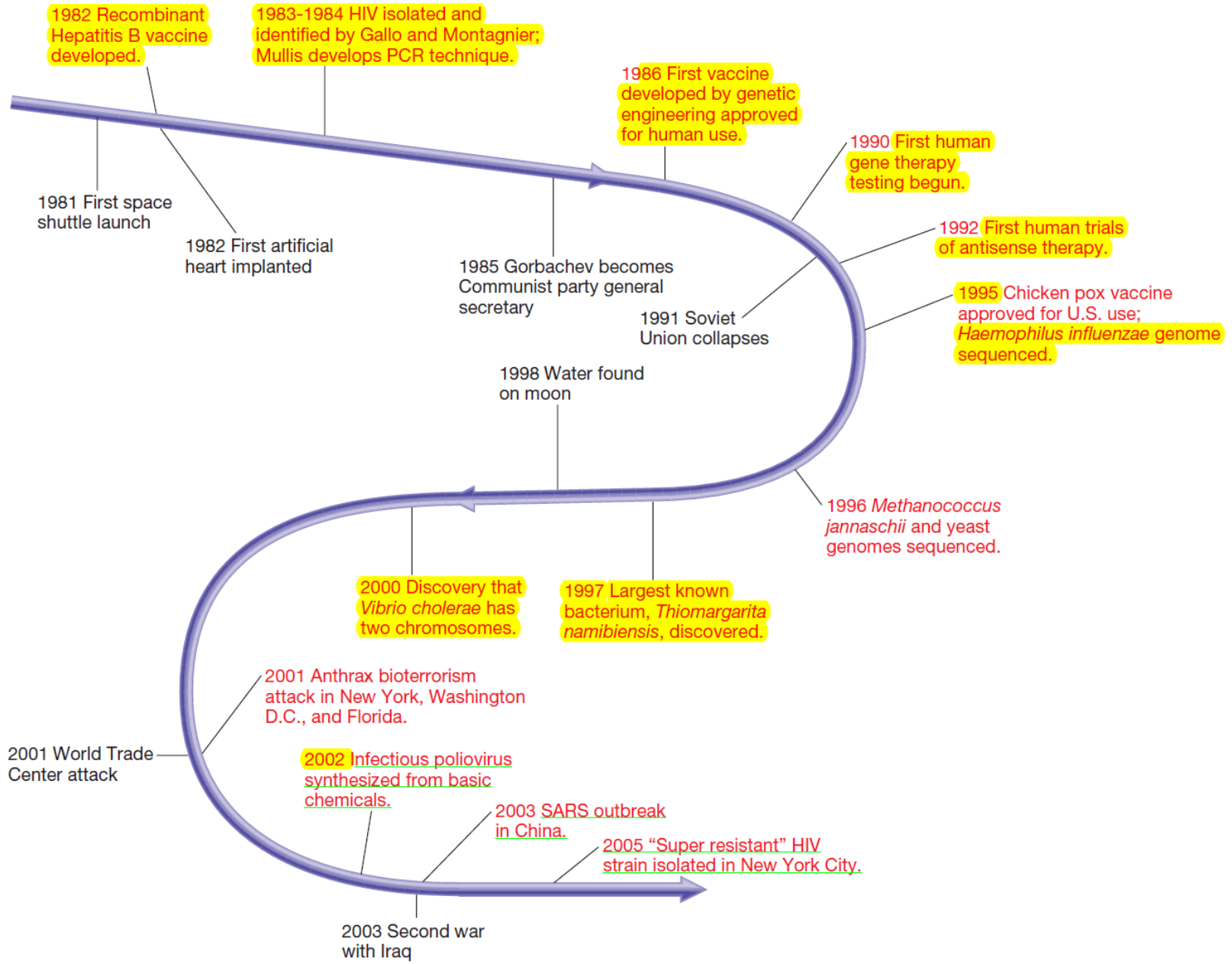
1857-1914


1546 Fracastoro suggests that invisible organisms cause disease.
1590–1608 Jansen develops first useful compound microscope.
1665 Hooke publishes *Micrographia*.
1688 Redi refutes spontaneous generation of maggots.
1676 Leeuwenhoek discovers "animacules".
1765–1776 Spallanzoni attacks spontaneous generation.
1543 Publication of Copernicus's work on heliocentric solar system
1600–1601 Shakespeare's *Hamlet*
1687 Newton's *Principia* published
1786 Miller produces first classification of bacteria.
1776 American Revolution
1798 Jenner introduces cowpox vaccination for smallpox.
1815 Battle of Waterloo; Napoleon defeated
1848 Marx's *Communist Manifesto*
1838–1839 Schwann and Schleiden propose the Cell Theory.
1859 Darwin's *Origin of Species*
1857 Pasteur describes fermentation.
1847–1850 Semmelweis introduces antiseptics to prevent disease.
1835–1844 Bassi discovers silkworm disease caused by fungus.
1861–1865 American Civil War
1861 Pasteur disproves spontaneous generation.
866 Dostoevsky's *rime and Punishment*
1867 Lister publishes on antiseptic surgery.
870–1871 Franco- erman War
1876–1877 Koch demonstrates anthrax caused by *Bacillus anthracis*.
1880 Laveran discovers *Plasmodium*, the cause of malaria.
1881 Koch cultures bacteria on gelatin; Pasteur develops anthrax vaccine.
1876 Bell invents telephone


1879 Edison's first light bulb
1884 Mark Twain's *Adventures of Huckleberry Finn*
1882 Koch discovers *Mycobacterium tuberculosis.*
1884 Koch's postulates published; Metchnikoff describes phagocytosis; autoclave developed; Gram stain developed.
1885-1886 First motor vehicle by Dainter
1888 Hertz discovers radio waves
1889 Oklahoma land rush
1885 Pasteur develops rabies vaccine; Escherich discovers *Escherichia coli.*
1889 Beijerinck isolates root nodule bacteria.
1887-1890 Winogradsky studies sulfur and nitrifying bacteria.
1887 Richard Julius Petri develops petri dish (plate).
1890 Eiffel Tower completed
1890 Von Behring's antitoxin for diptheria and tetanus
1891 Yellowstone becomes first national park
1894 Kitasato and Yersin discover *Yersinia pesits.*
1896 van Ermengem discovers *Clostridium botulinum.*
1899 Beijerinck proves virus causes tobacco mosaic disease.
1895 Bordet discovers complement.


1900 Reed proves yellow fever transmitted by mosquito.
1902 Landsteiner discovers blood groups.
1903 Wright and others discover antibodies.
1905 Schaudian and Hoffmann show *Treponema pallidum* causes syphilis.
1906 Wassermann develops complement fixation test for syphilis.
1900 Planck develops quantum theory
1903 Wright brothers' first powered aircraft
1905 Einstein's theory of relativity
1908 First Model T Ford
1910 Ricketts shows Rocky Mountain spotted fever caused by microbe.
1911 Rous discovers a virus can cause cancer.
1914 World War I begins
1917 Russian revolution
1915-1917 D'Herelle and Twort discover bacterial viruses.
1927 Lindberg's transAtlantic flight
1928 Griffith discovers bacterial transformation.
1923 First edition of *Bergey's Manual.*
1921 Fleming discovers lysozyme.
1929 Stock market crash
1929 Fleming discovers penicillin.
1931 Van Niel studies photosynthetic bacteria.


1933 Ruska develops electron microscope.
1935 Domagk discovers sulfa drugs.
1937 Chatton divides living organisms into procaryotes and eucaryotes.
1933 Hitler becomes chancellor of Germany
1937 Krebs discovers citric acid cycle
1939 World War II begins
1941 Beadle and Tatum propose one-gene-one-enzyme theory.
1945 Atomic bomb dropped on Hiroshima
1944 Waksman discovers streptomycin.
1957 Sputnik launched by Soviet Union
1950 Korean War begins
1949 Enders, Weller, and Robbins grow poliovirus in human tissue culture.
1959 Yalow develops radioimmunoassay.
1955 Jacob and Wollman discover F-factor plasmid.
1953 Watson and Crick propose DNA double helix.
1961 First human in space
1961 Jacob and Monod propose lac operon.
1962 First quinolone synthesized.
1962 Cuban missile crisis
1977 Woese divides procaryotes into Bacteria and Archaea.
1979 Insulin synthesized using recombinant DNA; smallpox officially declared eradicated.
1970 Arber and Smith discover restriction endonucleases.
1980 Development of scanning tunneling microscopes.
1969 Neil Armstrong walks on the moon
1973 Vietnam War ends
1979 Three Mile Island disaster
1980 First home computers


1982 Recombinant Hepatitis B vaccine developed.
1983-1984 HIV isolated and identified by Gallo and Montagnier; Mullis develops PCR technique.
1986 First vaccine developed by genetic engineering approved for human use.
1990 First human gene therapy testing begun.
1992 First human trials of antisense therapy.
1995 Chicken pox vaccine approved for U.S. use; *Haemophilus influenzae* genome sequenced.
1996 *Methanococcus jannaschii* and yeast genomes sequenced.
1997 Largest known bacterium, *Thiomargarita namibiensis*, discovered.
2000 Discovery that *Vibrio cholerae* has two chromosomes.
2001 Anthrax bioterrorism attack in New York, Washington D.C., and Florida.
2002 Infectious poliovirus synthesized from basic chemicals.
2003 SARS outbreak in China.
2005 "Super resistant" HIV strain isolated in New York City.
2003 Second war with Iraq
2001 World Trade Center attack
1981 First space shuttle launch
1982 First artificial heart implanted
1985 Gorbachev becomes Communist party general secretary
1991 Soviet Union collapses
1998 Water found on moon

Germ theory of disease

Microorganism causes disease

Agostino Bassi (1773–1856) first showed a microorganism

could cause disease when he demonstrated in 1835 that a silkworm disease was due to a fungal infection.

In 1845, M. J. Berkeley proved that the great Potato Blight of Ireland was caused by a water mold

in 1853, Heinrich de Bary showed that smut and rust fungi caused cereal crop diseases.

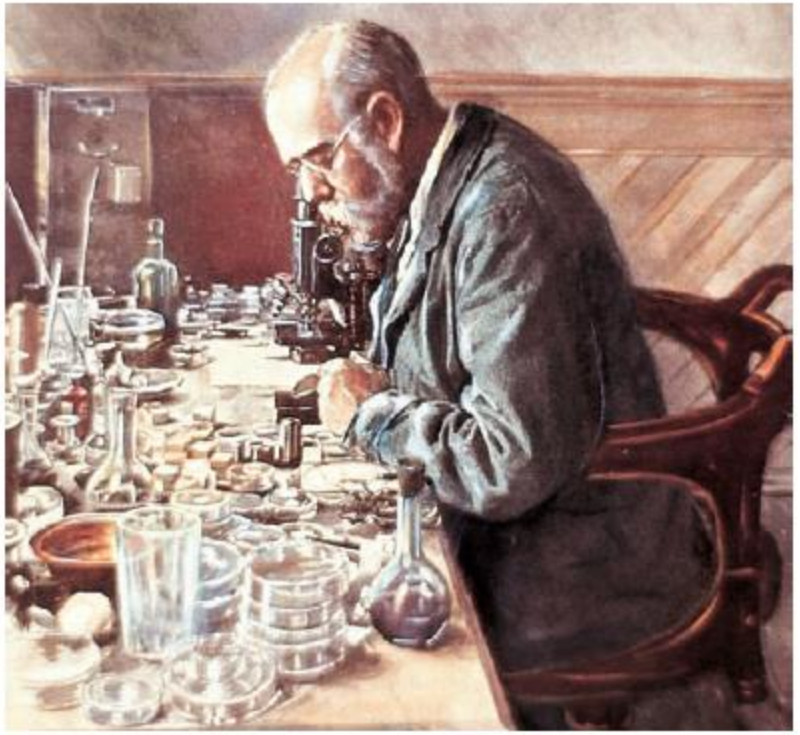
- Joseph Lister (1827–1912)

  developed a system of antiseptic surgery

  heat sterilized, and phenol was used on surgical dressings and at

  times sprayed over the surgical area

Robert Koch



First demonstrated the role of bacteria causing disease

He isolated the organism *Bacillus anthracis* , the causative agent of anthrax

Mycobacterium tuberculosis also discovered

Pure culture techniques introduced

He cultured organism on sterile cut surfaces of boiled potatoes

He first tried the use of gelatin as a solidifying agent for the medium, it is not an ideal solidifying agent as it can be digested by many bacteria and also melts at 28^{o}C

KOCH POSTULATES

1. Microorganism must be present in every case of disease but absent from healthy organisms

2. The suspected microorganism must be isolated and grown in pure culture

3. The same disease must result when the isolated microorganism is inoculated into healthy host

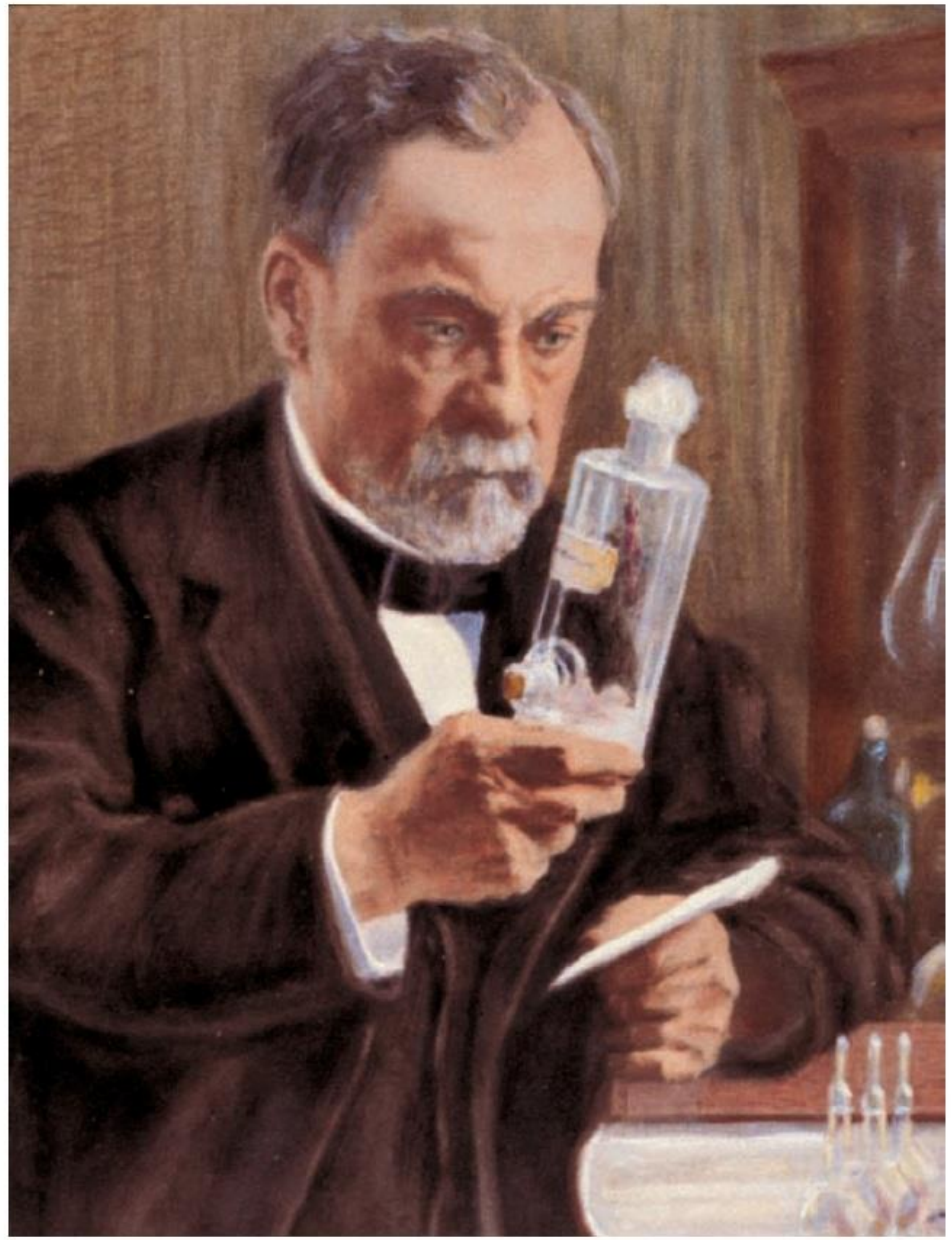
4.The same microorganism must be isolated again from the diseased host

Other discoveries

Charle’s Chamberland constructed bacterial porcelain filter

Dimitri ivanosky and Marinus Bejerink- Tobacco mosaic virus

Louis Pasteur



Pasteur and Rox discovered that incubating the culture for long intervals between tranfers will attenuate the bacteria, that is they lost their ability to cause disease

He called this attenuated culture as vaccine

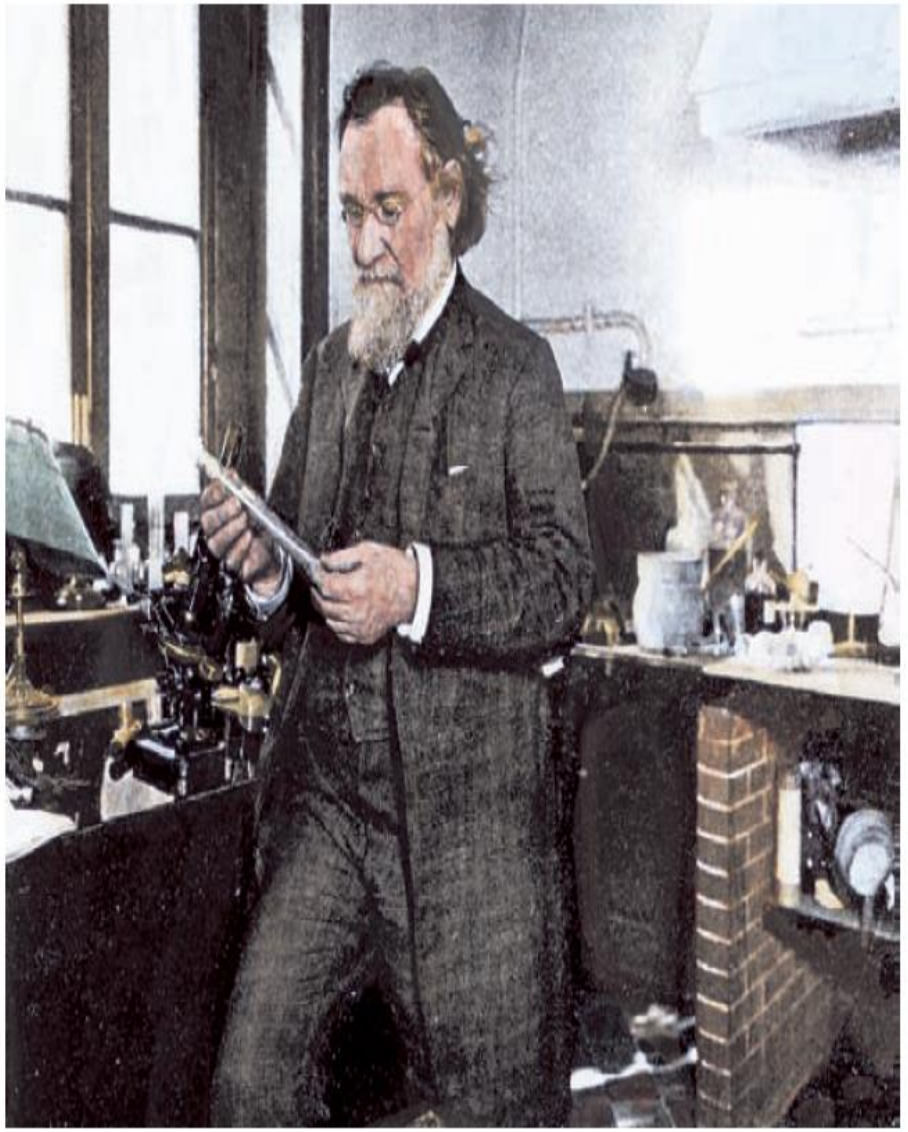
Louis Pasteur developed the term vaccine to give respect to Edward Jenner , who used cow pox lesions to protect from small pox

Pasteur and Chamberland developed an attenuated anthrax vaccine in two ways: by treating the with Potassium bichromate and by incubating bacteria at 42^{o}C to 43^{o}C

Pasteur prepared Rabies vaccine by inoculating into Heterologous host Rabbit in which virulent rabies virus and then , once the animal dies, its brain and spinal cord dried and used as vaccine

Emil von Behring and Shibasaburo Kitasato, developed anti toxin

Elie Metchnikoff discovered phagocytes and phagocytosis



Thank you