Foundations in Microbiology

Fifth Edition

Talaro

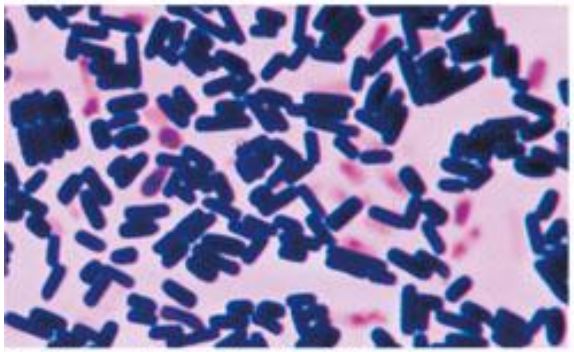
Chapter

1

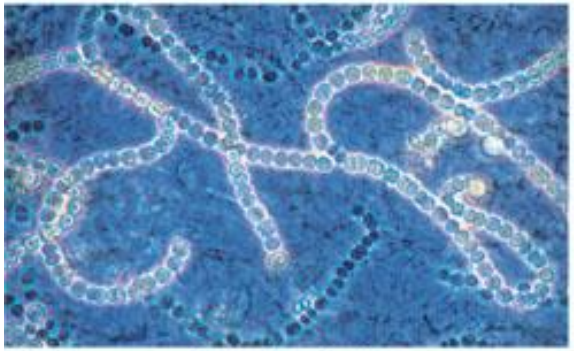
Microbiology

- The study of of organisms too small to be seen without magnification
  - bacteria
  - viruses
  - fungi
  - protozoa
  - helminths (worms)
  - algae

(a) Examples of procaryotic organisms



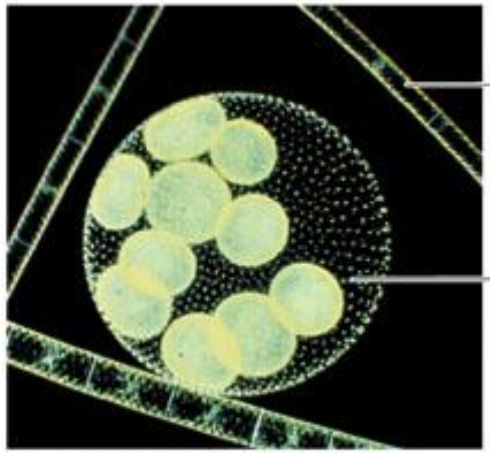
Rod-shaped bacteria, *Clostridium*, found in soil



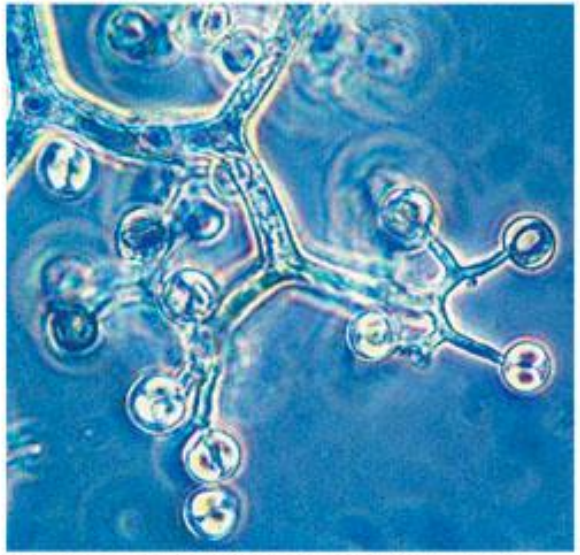
Nostoc, a cyanobacterium that lives in fresh water

(b) Examples of eucaryotic organisms

The stalked protozoan *Vorticella* is shown in feeding mode. These free-living eucaryotes are common in pond water.



Representatives of algae. *Volvox* is a large, complex colony composed of smaller colonies (spheres) and cells (dots). *Spirogyra* is a filamentous alga composed of elongate cells joined end to end.



Example of a fungus; shown here is the mold *Thamnidium* displaying its sac-like reproductive vessels.

Branches of study within microbiology

- Immunology
- Public health microbiology & epidemiology
- Food, dairy and aquatic microbiology
- Biotechnology
- Genetic engineering & recombinant DNA technology

Microbes are involved in

- nutrient production & energy flow
- decomposition
- production of foods, drugs & vaccines
- bioremediation
- causing disease

Impact of pathogens

- Nearly 2,000 different microbes cause diseases
- 10 B infections/year worldwide
- 13 M deaths from infections/year worldwide

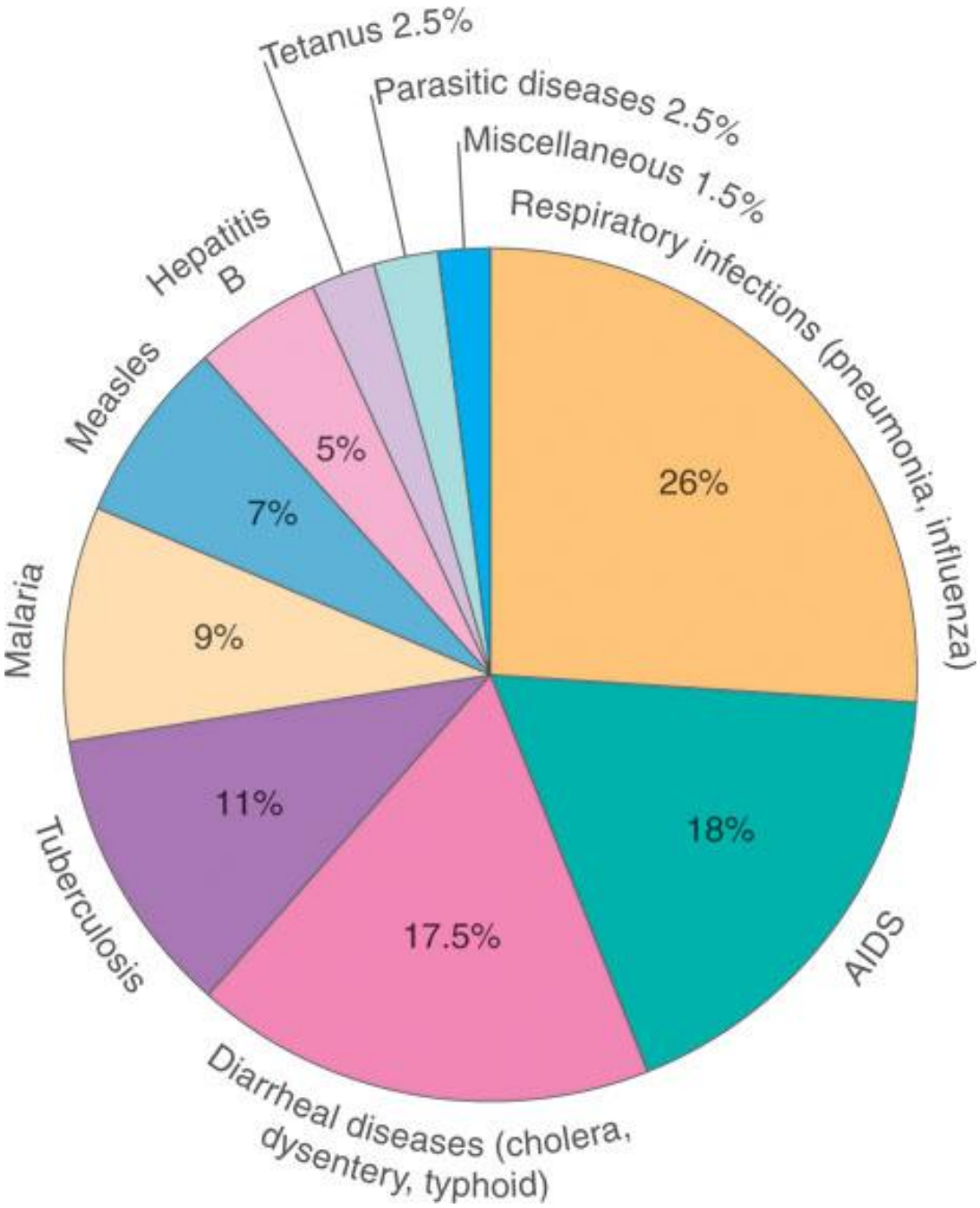
TABLE 1.1

Top Causes of Death—All Diseases

United States	No. of Deaths	Worldwide	No. of Deaths
1. Heart disease	725,000	1. Heart disease	11.1 million
2. Cancer	550,000	2. Cancer	7.1 million
3. Stroke	167,000	3. Stroke	5.5 million
4. Chronic lower-respiratory disease	124,000	4. Respiratory infections[1]	3.9 million
5. Unintentional injury (accidents)	97,000	5. Chronic lower-respiratory disease	3.6 million
6. Diabetes	68,000	6. Accidents	3.5 million
7. Influenza and pneumonia	63,000	7. HIV/AIDS	2.9 million
8. Alzheimer disease	45,000	8. Perinatal conditions	2.5 million
9. Kidney problems	35,000	9. Diarrheal diseases	2.0 million
10. Septicemia (bloodstream infection)	30,000	10. Tuberculosis	1.6 million

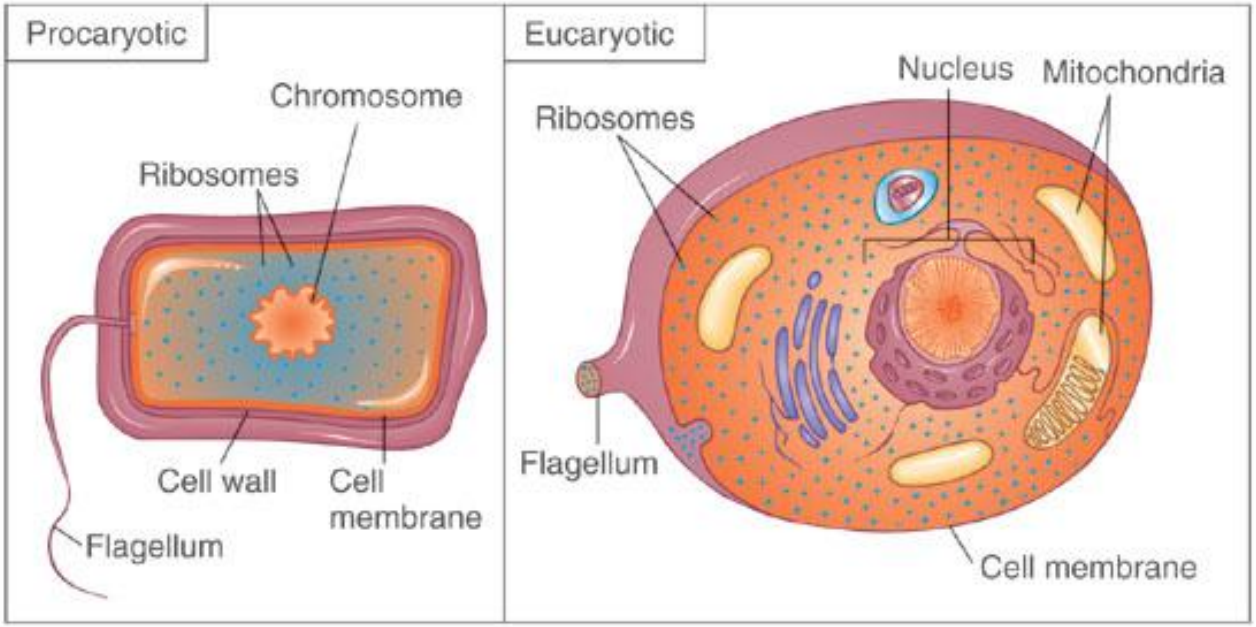
[1] *Diseases in red are those most clearly caused by microorganisms.*

Data adapted from The World Health Report 2002 (World Health Organization).



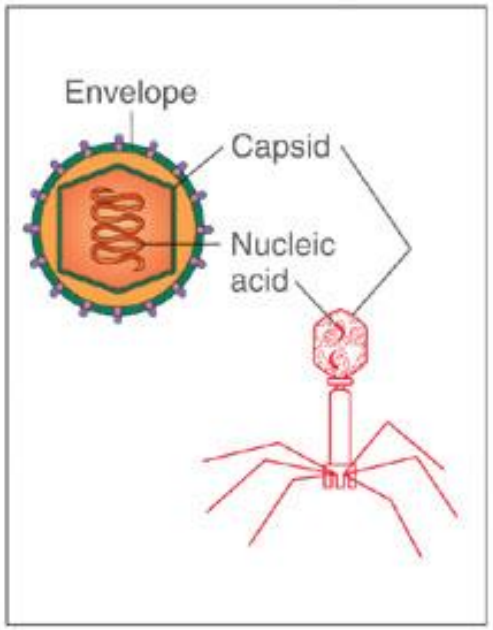
Characteristics of microbes

(a) Cell Types

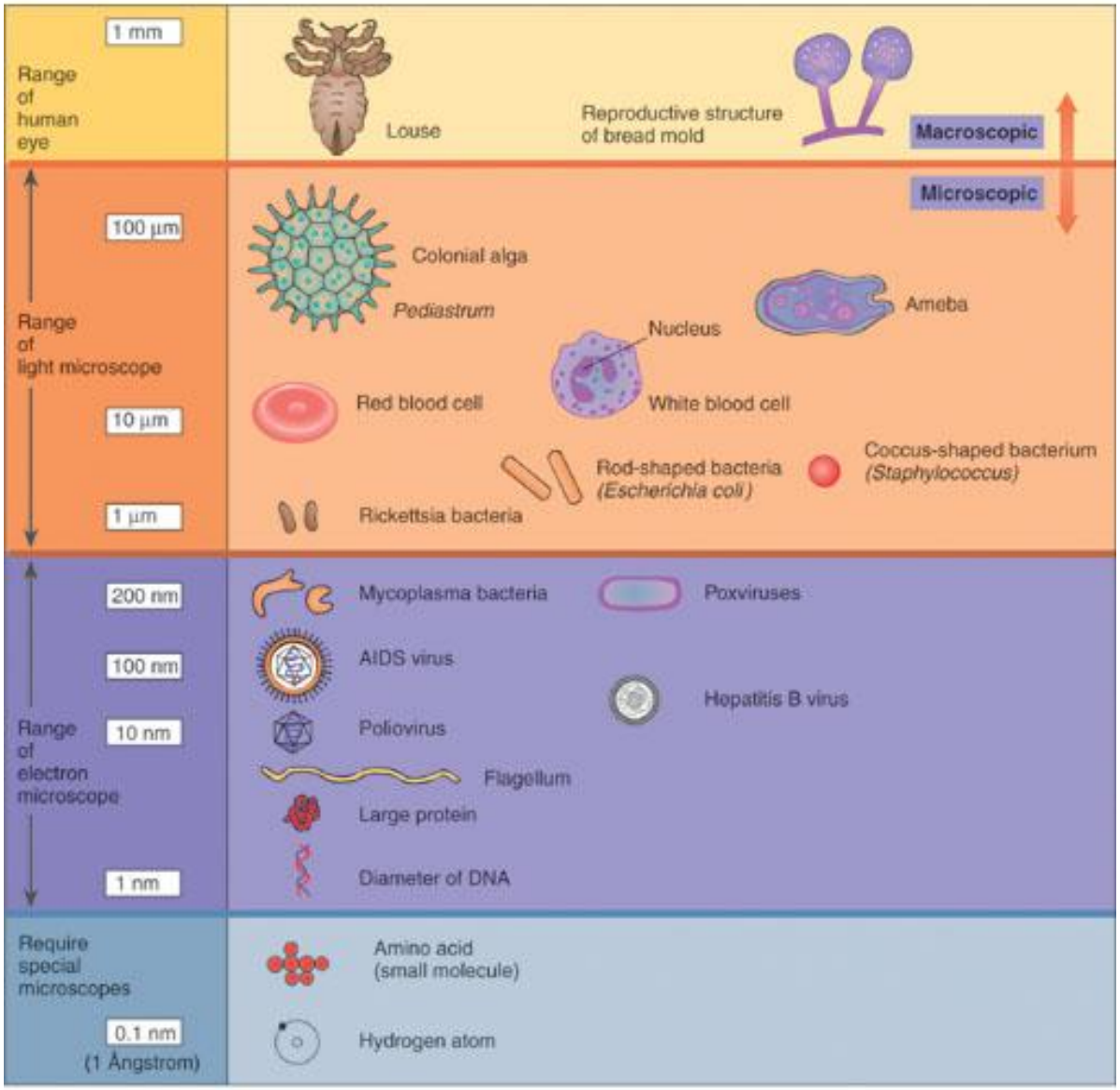


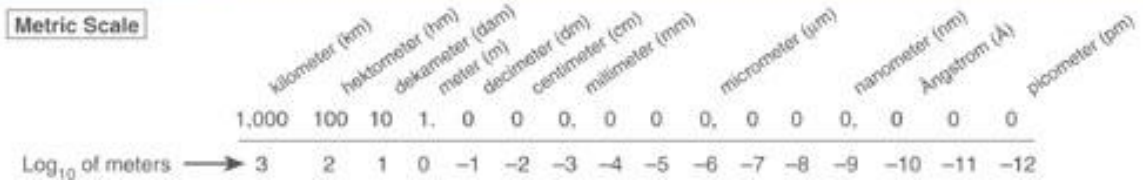
Microbial cells are of the small, relatively simple procaryotic variety (left) or the larger, more complex eucaryotic type (right).

(b) Virus Types



Viruses are tiny particles, not cells, that consist of genetic material surrounded by a protective covering. Shown here are a human virus (top) and bacterial virus (bottom).

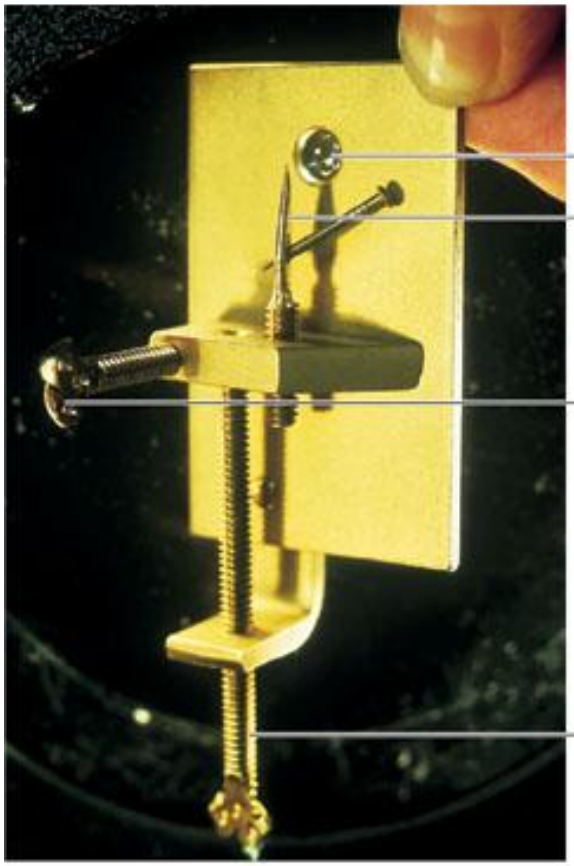




Antonie van Leeuwenhoek

- First to observe living microbes
- his single-lens magnified up to 300X

(1632-1723)



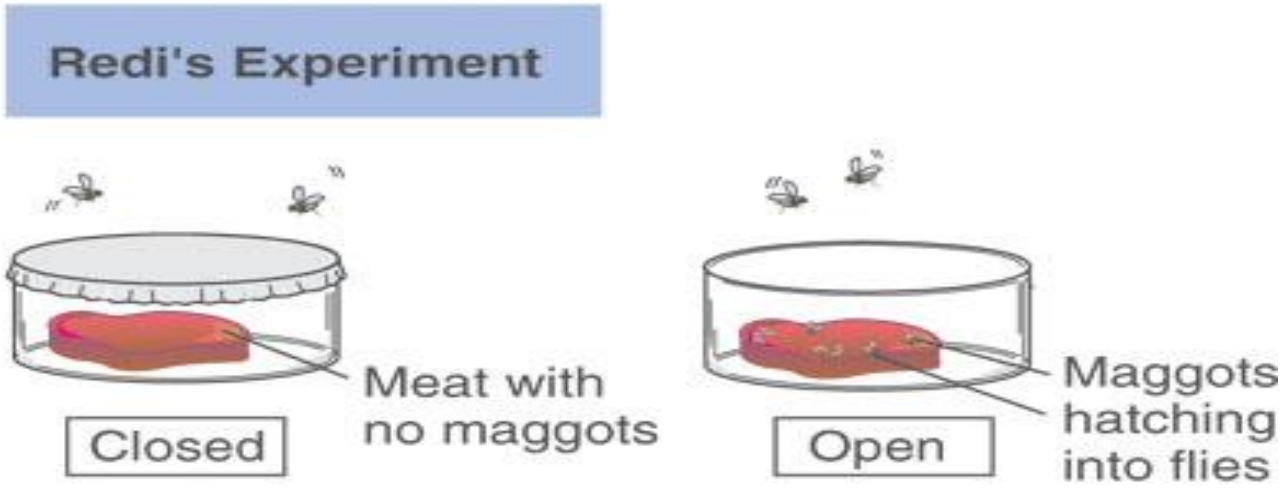
(a)

(b)

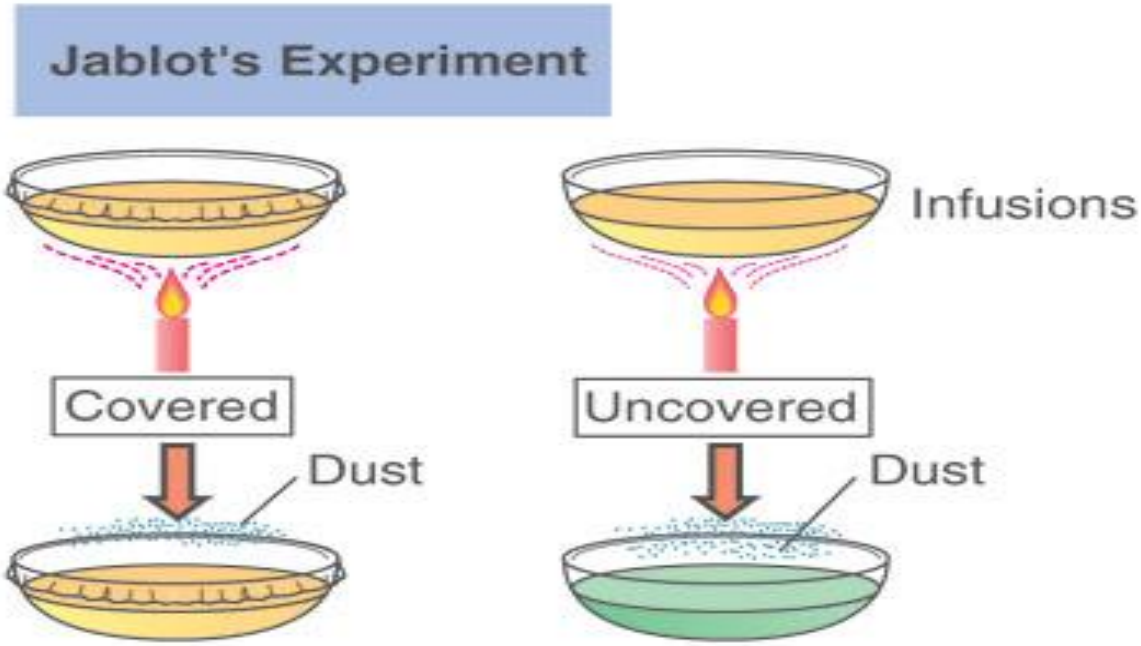
Spontaneous generation

Early belief that some forms of life could arise from vital forces present in nonliving or decomposing matter.

(flies from manure, etc)

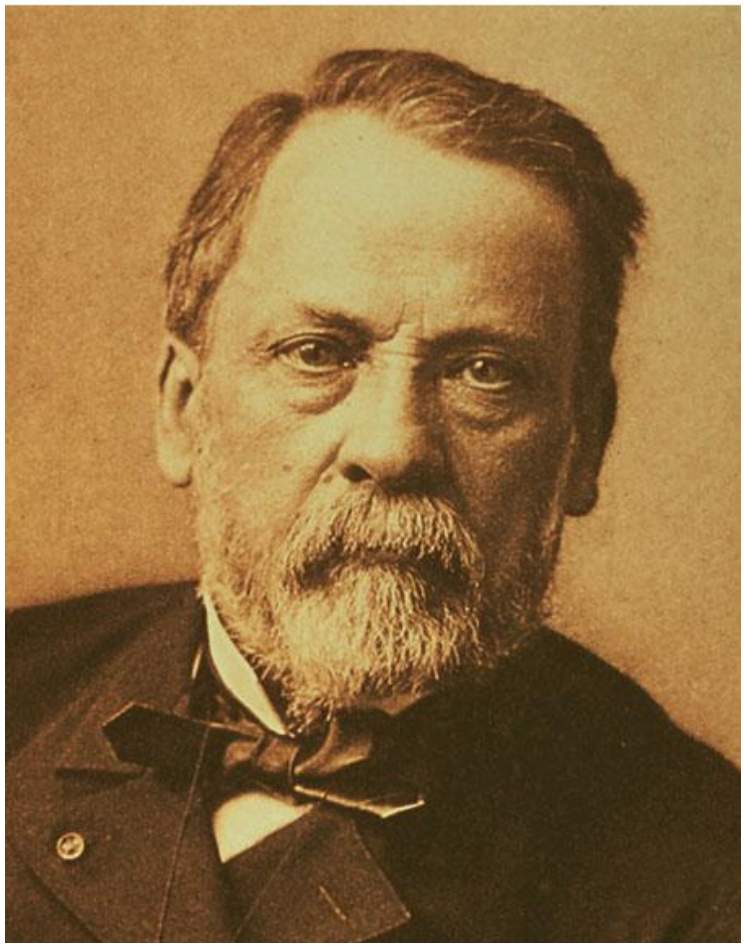


(a)



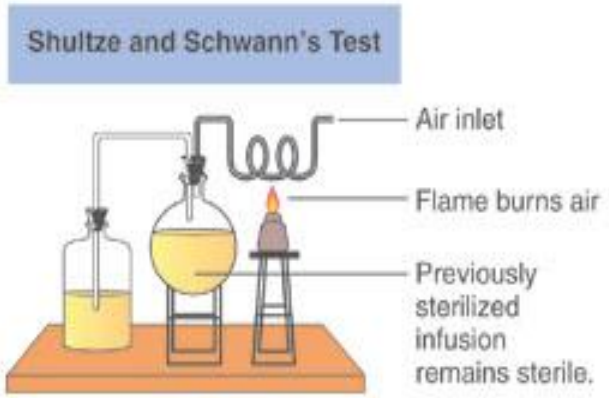
(b)

Louis Pasteur

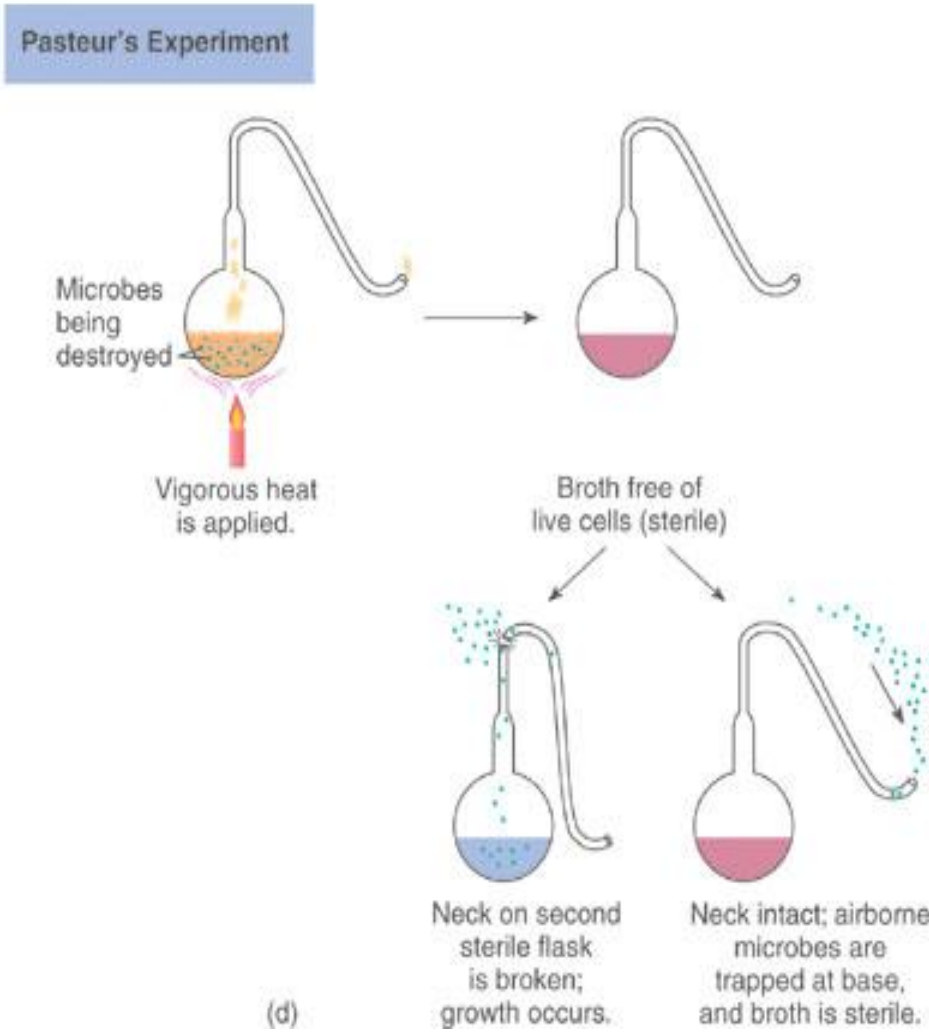


(1822-1895)

- Showed microbes caused fermentation & spoilage
- Disproved spontaneous generation of m.o.
- Developed aseptic techniques.
- Developed a rabies vaccine.



(c)

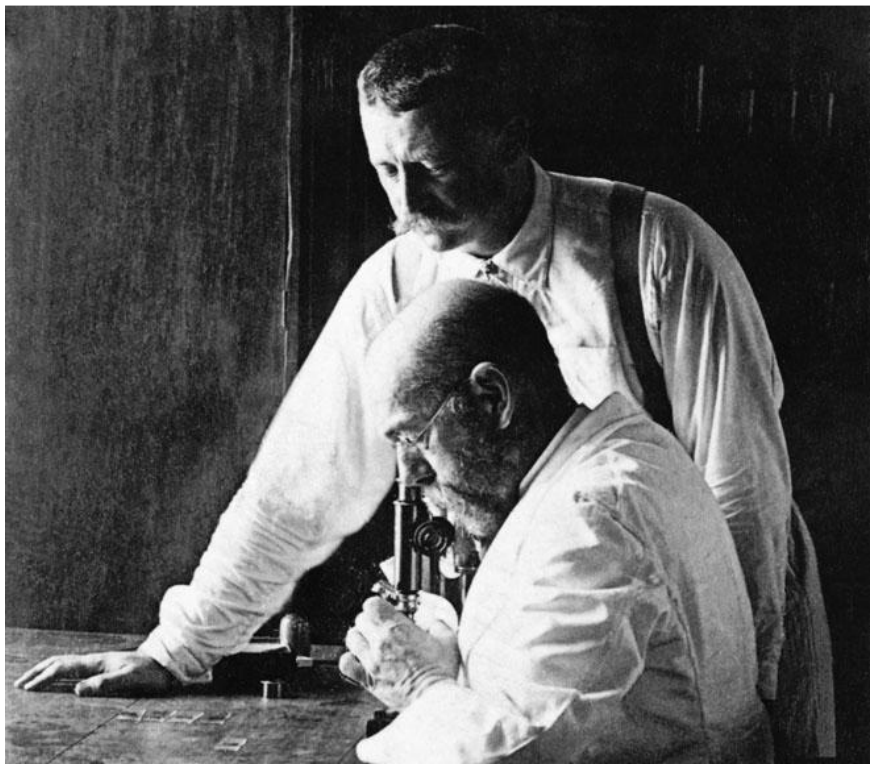


(d)

Germ theory of disease

Many diseases are caused by the growth of microbes in the body and not by sins, bad character, or poverty, etc.

Robert Koch



(1843-1910)

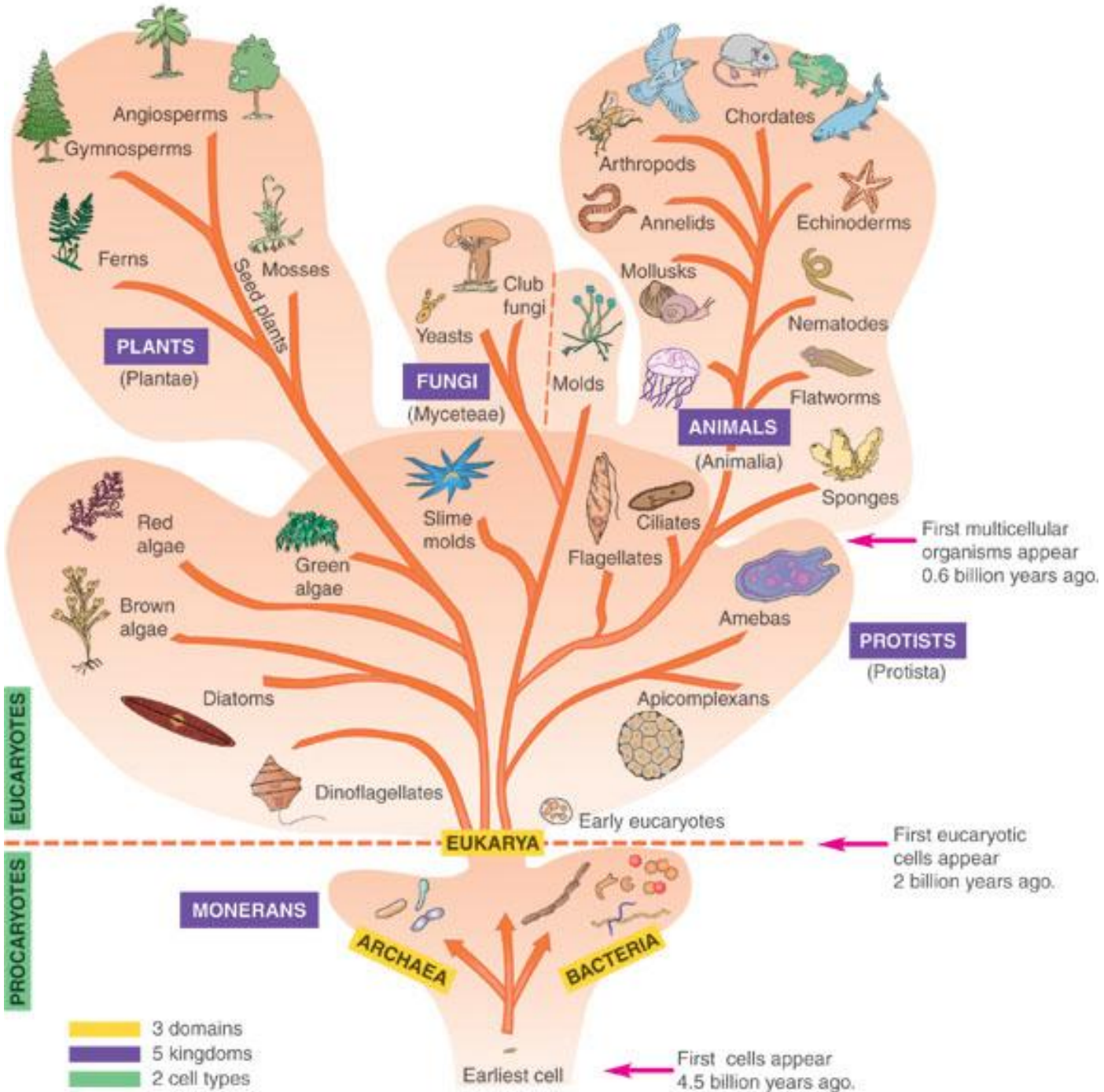
- Established a sequence of experimental steps to show that a specific m.o. causes a particular disease.
- Developed pure culture methods.
- Identified cause of anthrax, TB, & cholera.

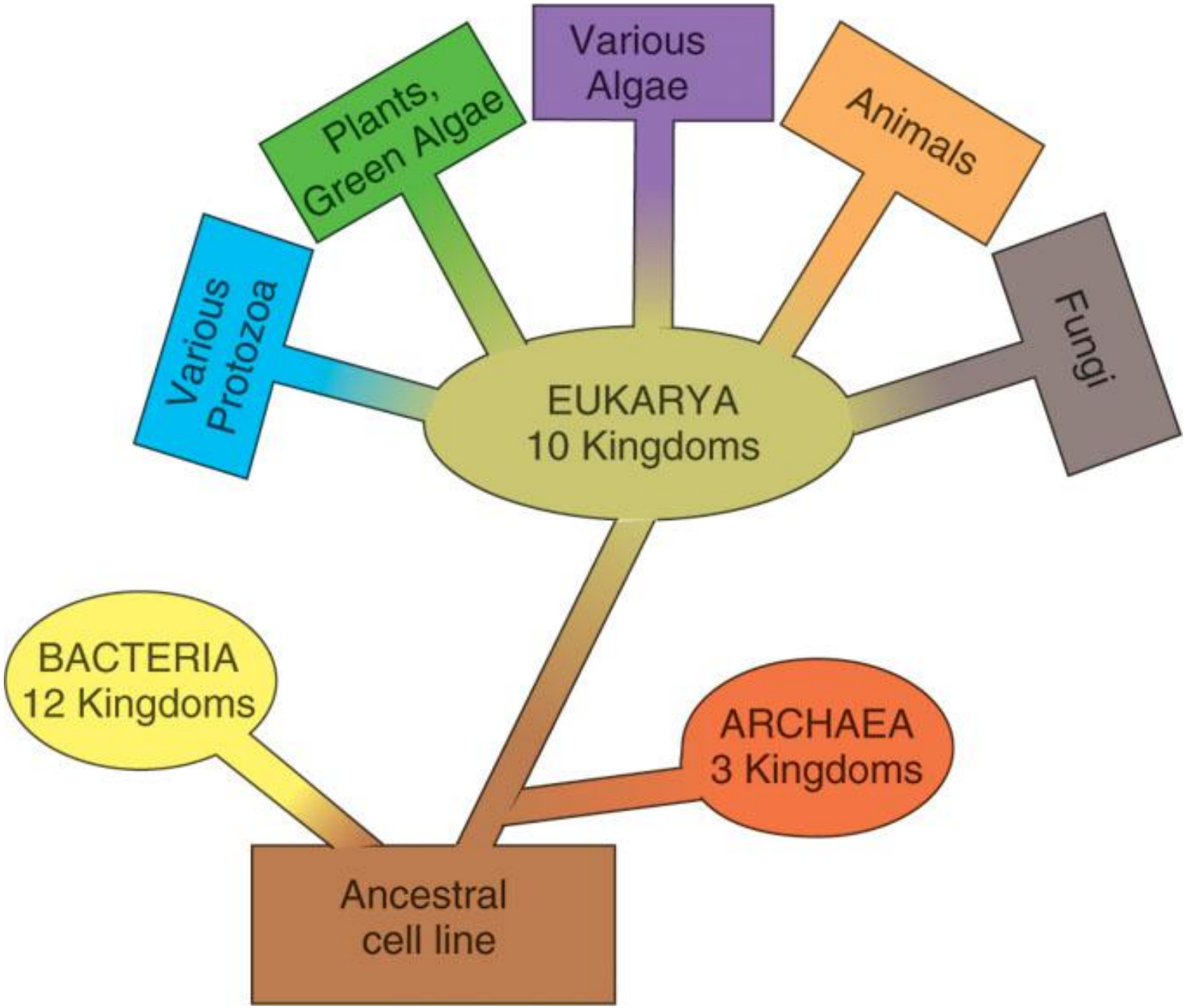
Taxonomy - system for organizing, classifying & naming living things

- Domain - Archaea, Bacteria & Eukarya
- Kingdom - 5
- Phylum or Division
- Class
- Order
- Family
- Genus
- species

3 domains

- Eubacteria -true bacteria, peptidoglycan
- Archaea –odd bacteria that live in extreme environments, high salt, heat, etc
- Eukarya- have a nucleus, & organelles





Naming micoorganisms

- Binomial (scientific) nomenclature
- Gives each microbe 2 names
  - **Genus -** noun, always capitalized
  - **species -** adjective, lowercase
- Both italicized or underlined
  - *Staphylococcus aureus (S. aureus)*
  - *Bacillus subtilis (B. subtilis)*
  - *Escherichia coli (E. coli)*

Evolution- living things change gradually over millions of years

- Changes favoring survival are retained & less beneficial changes are lost.
- All new species originate from preexisting species.
- Closely related organism have similar features because they evolved from common ancestral forms.
- Evolution usually progresses toward greater complexity.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