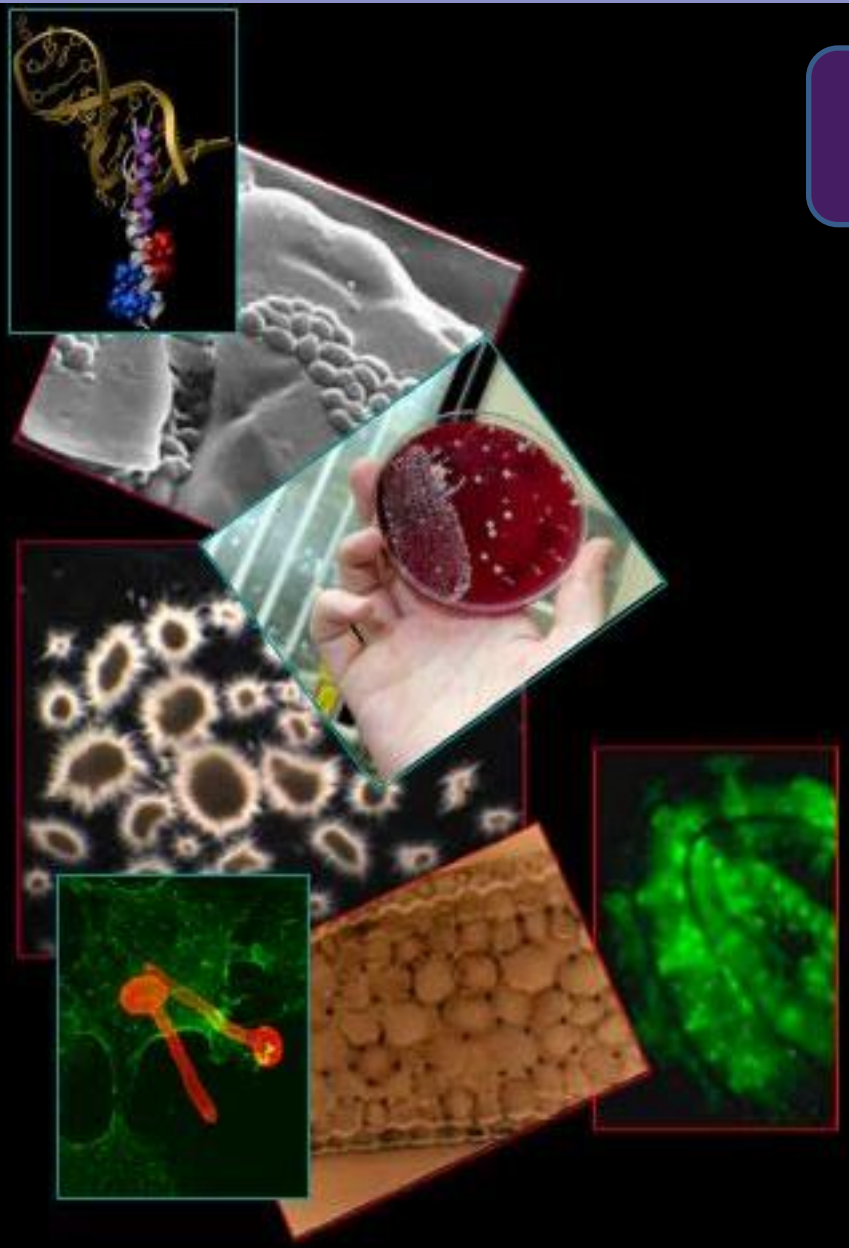

Food Microbiology

Course Contract

Dian Widya Ningtyas
Mochamad Nurcholis

Food Science Department
Brawijaya University
2013

LECTURER

Dian Widya Ningtyas, STP,MP

M. Nurcholis, STP,MP

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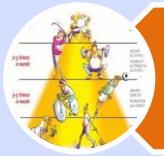
Master (S-2)	Agicultural Product & Technology (Food Science)	Brawijaya	2008

COURSE CONTRACT

Come on time

Silent your cell phone

Manage your tasks/assignment



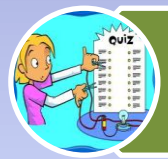
Actively participate

Read, Read more and more

Think creatively

Score Grading

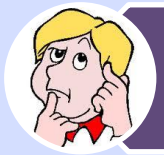
Assignment 20%



Quiz 10%

Middle Test 20%

Final Test 20%



Activity 10%

Practicum 20%

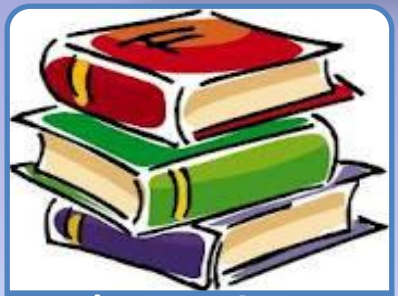
COURSE TOPICS

Week	Topics	Lecturer
1	Course Contract, Definition, Concept, and Scope of Microbiology	MNC
2	Classification of Bacteria, Yeast and Mold	MNC
3	Classification of Virus, Algae, Protozoa, Mycoplasma, and Ricketsia	MNC
4	Physiology and Metabolism of Microorganisms	MNC
5	Microorganisms and Environment (Biotic and Abiotic)	MNC
6	Microbiology Technique (Microbial Isolation)	MNC
7	Factors Influenced of Microbial Growth (FATTOM)	DWN
8 Middle Test (UTS)		

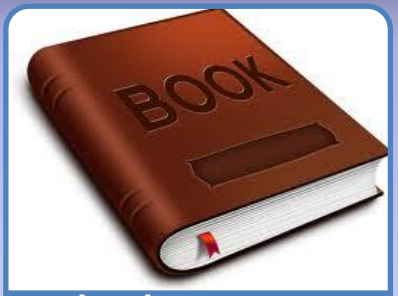
COURSE TOPICS

Week	Topics	Lecturer
9	Thermophilic Microorganisms	DWN
10	Psycrophilic Microorganisms	DWN
11	Mesophilic Microorganisms	DWN
12	The role & Microbial Application in Food	DWN
13	Qualitative & Quantitative Analysisis of Microorganisms in Food	DWN
14	Food Spoilage and Foodborne Diseases	DWN
15 Final Test (UAS)		

REFERENCES

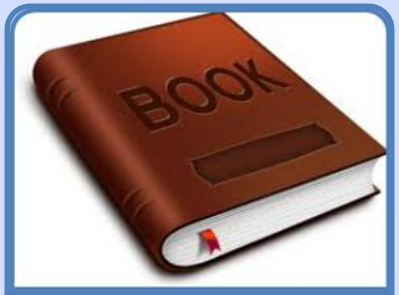


Pelczar & Chan

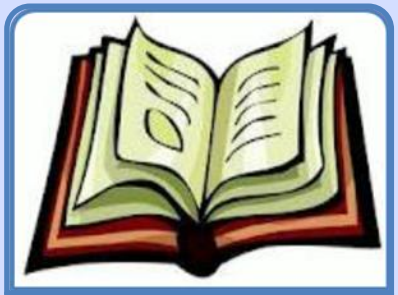


Bibek Ray

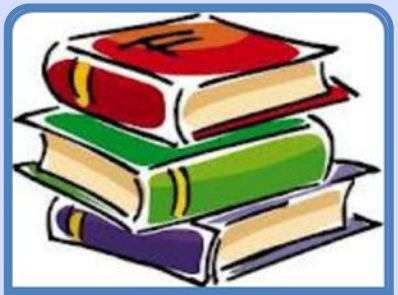
Dwijdo-seputro



Frazier, WC



Jawet & Adelberg



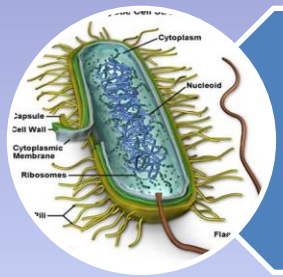
Kingsbury & Wagner

Food Microbiology

Definition, Concept and Scope of Microbiology

Mochamad Nurcholis
Food Science Department
Brawijaya University
2013

OVERVIEW

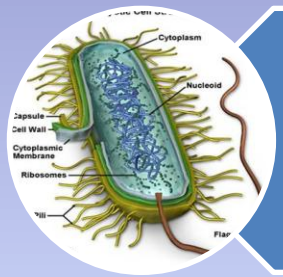


Definition & Role

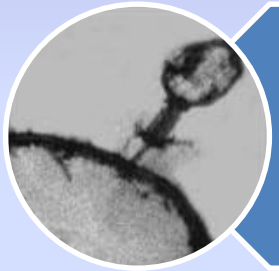
History & Development

Classification of Living Microorganisms

Introduction to Microbiology



What is Microbiology?



What do we know about Microbiology?

What is Microorganisms?

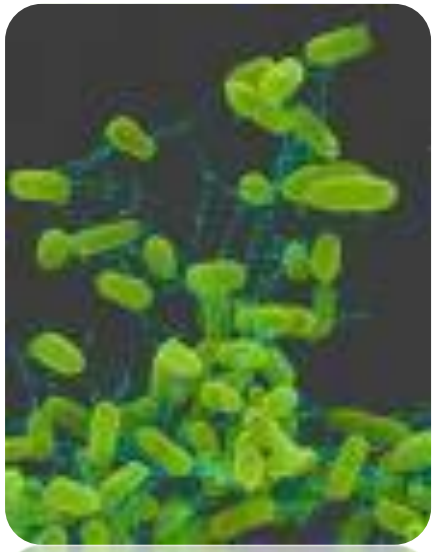
Introduction: Definitions

- **Microbiology**
  - The basic science of understanding microbial life
  - The applications of science to human needs.

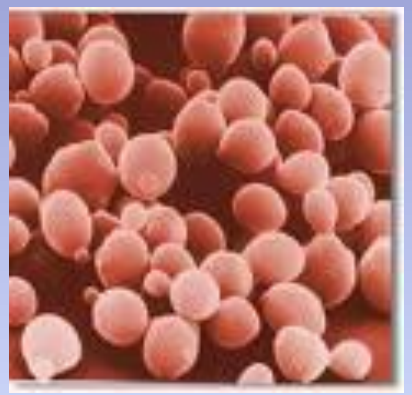
- **Microorganisms**
  - Organisms that are distinct form macroorganisms
  - Diverse group
  - Exist as single cells (**unicellular**) or in cell clusters (**multicellular**)

Definition of Microorganims

- ***Microbiology*** – *Gr. mikros* : small, *bios* : life, *logos* : science
- ***Microscopic*** – *Gr. mikros:* small and *scopion:* to see
- *Branch of biological science which study the "microscopic" organism*
- Microorganisms are **ubiquitous**
- The study of organisms too small to be seen without magnification
- **Microorganisms include**:
  - bacteria
  - viruses
  - fungi
  - protozoa
  - helminths (worms)
  - algae



Various Microorganisms



Yeast

Virus

Algae

Protozoa

Molds

Bacteria

Introduction: The importance of Microbiology

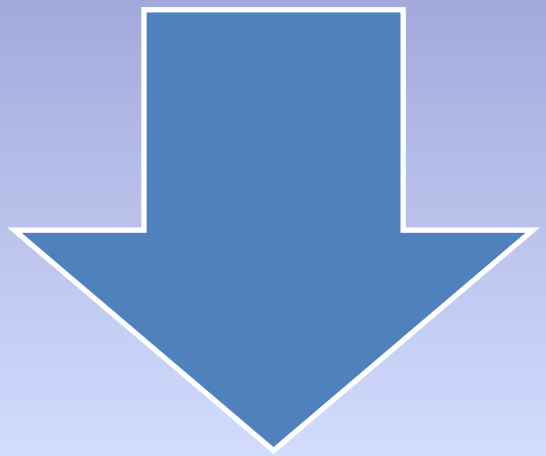
- **Microorganisms** are **excellent models** for **understanding cell function** in higher organisms, including humans.

- Because microorganisms are **central to the very functioning of the biosphere**, the science of microbiology is the foundation of all the biological sciences

Branches of Study Within Microbiology

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

The Role of Microorganisms



Positive :

1. Fermented Foods
2. Metabolite Producer
3. Host Cell

Negative :

1. Food Spoilage
2. Food borne diseases

Positive Role

Vinegar

Yoghurt

Pickle

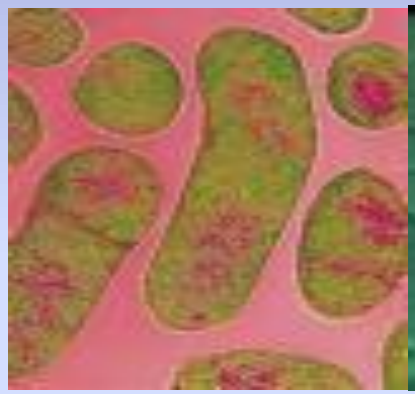
Roti

Keju

Tempeh

Negative Role

- Cause disease (basis for bioterrorism)



Clostridium

Salmonella

- Food spoilage

Microbes are Involved in

- Nutrient production and energy flow
- Decomposition
- Biotechnology
  - production of foods, enzyme, drugs and vaccines
- Genetic engineering
- Bioremediation
- Infectious disease

Landmarks in Microbiology

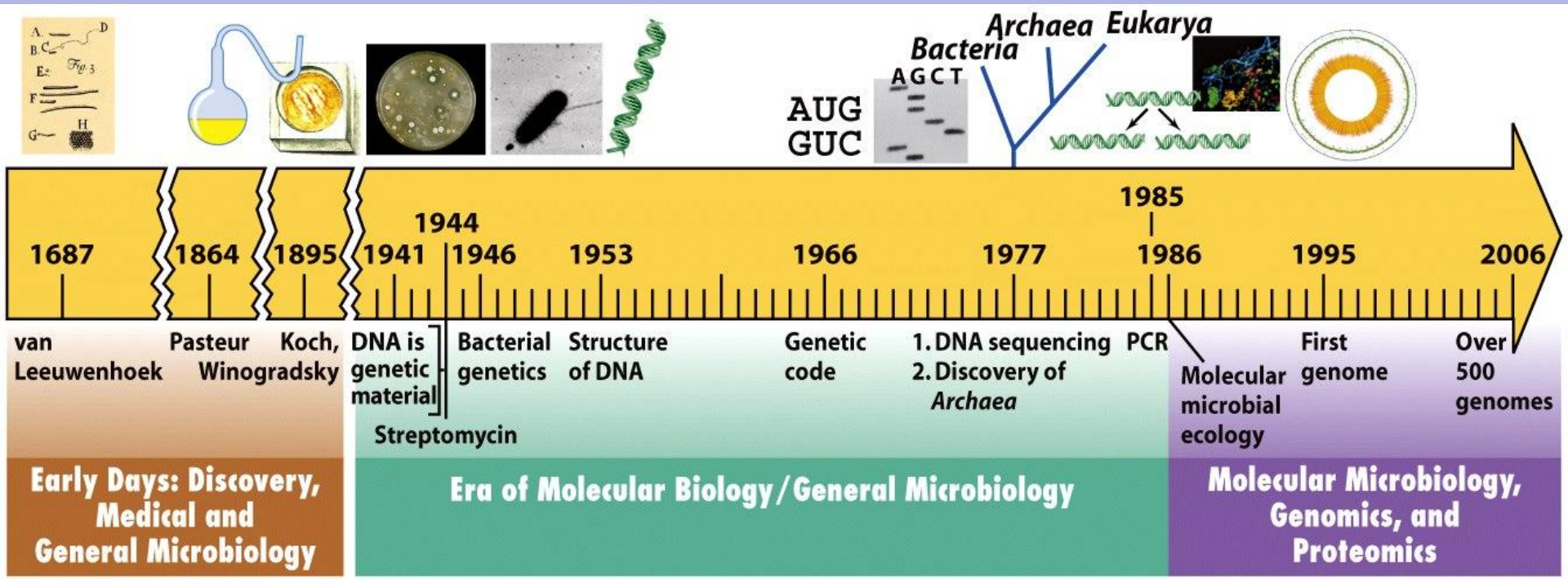


Figure 1-17 Brock Biology of Microorganisms 11/e

Discovery of Microorganisms

1658
- **Athanasius Kircher** : had seen **living worm** in putrid meat & milk.

1664
- **Robert Hooke** : described the structure of **molds** by using simple microscope.

1675
- **Antonie van Leeuwenhoek** : observe **bacteria** by using microscope (< 300x magnification power)

- Abiogenesis vs Biogenesis

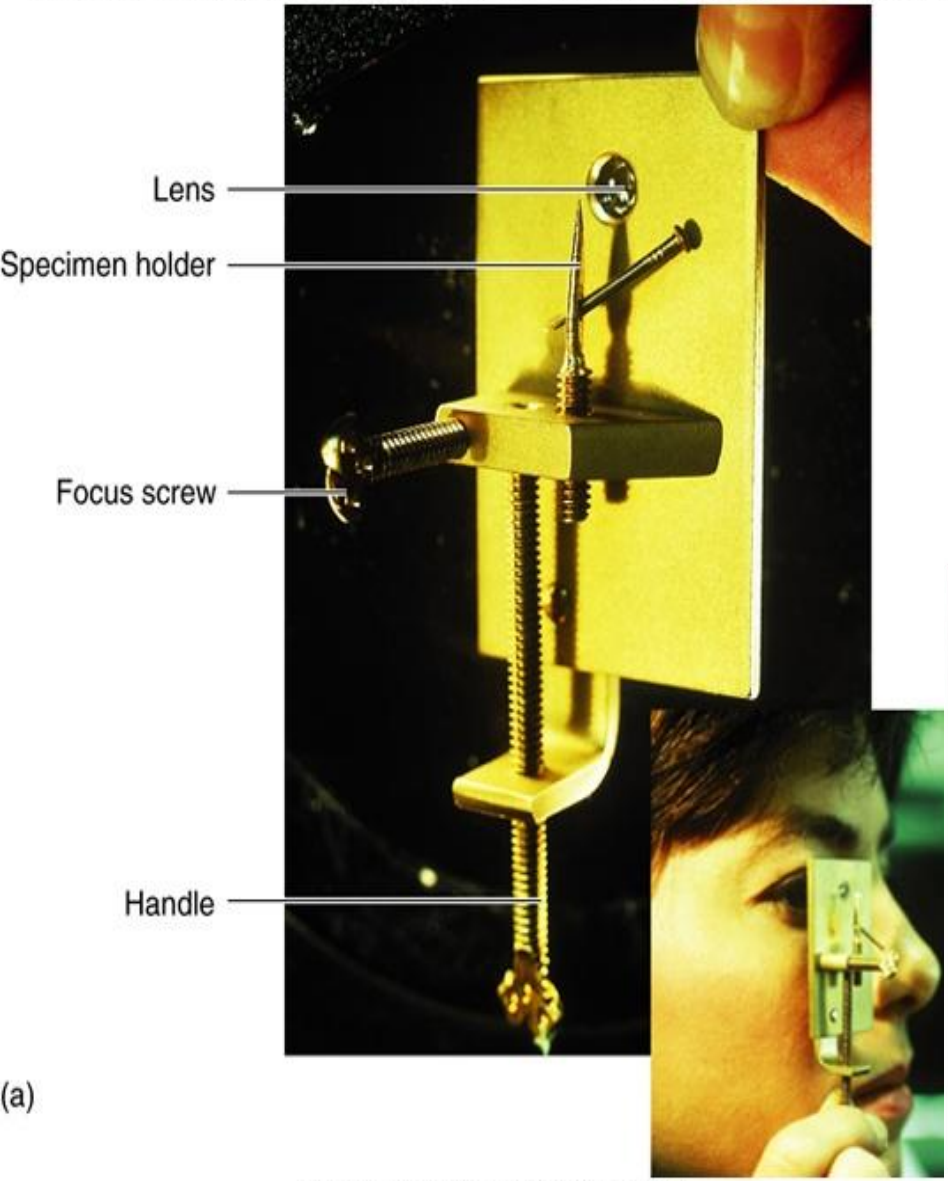
History: The First Description of Microorganisms

- **Robert Hooke** observed fruiting **structures of molds** in 1665 and was the first to describe microorganisms.

Antonie van Leeuwenhoek (1632-1723)

- Dutch linen merchant
- First to observe **different type** of living microbes
- Single-lens magnified up to 300X
- Describe **bacteria** in 1676
- The first scientist to describe bacteria

Van Leeuwenhoek's Microscope



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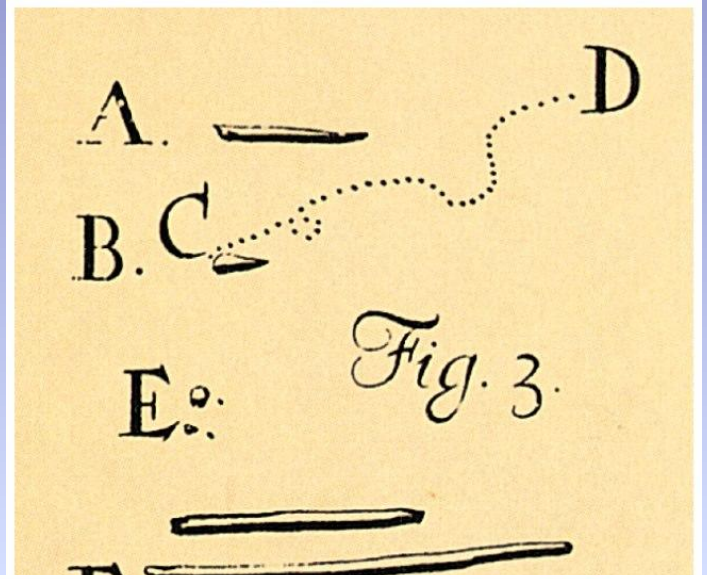
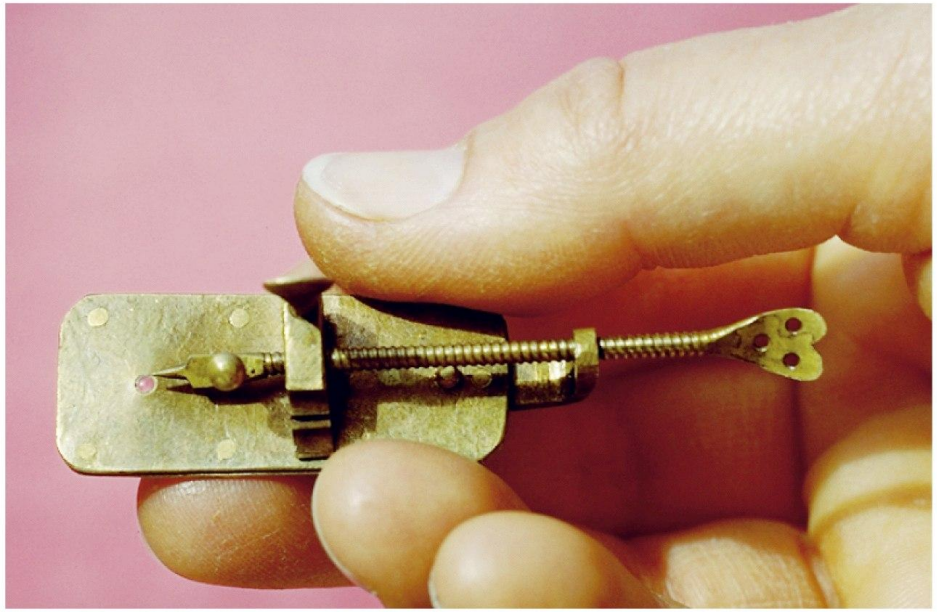




T. D. Brock

Figure 1-9a Brock Biology of Microorganisms 11/e

The Concept of Biogenesis Replaces Spontaneous Generation Theory

- **Spontaneous generation** claims that life can originate from non-living matter.
- **Biogenesis** states that living cells originate from living cells.
- Louis Pasteur's disproved spontaneous generation.
- His work led to the development of methods for controlling the growth of microorganisms.

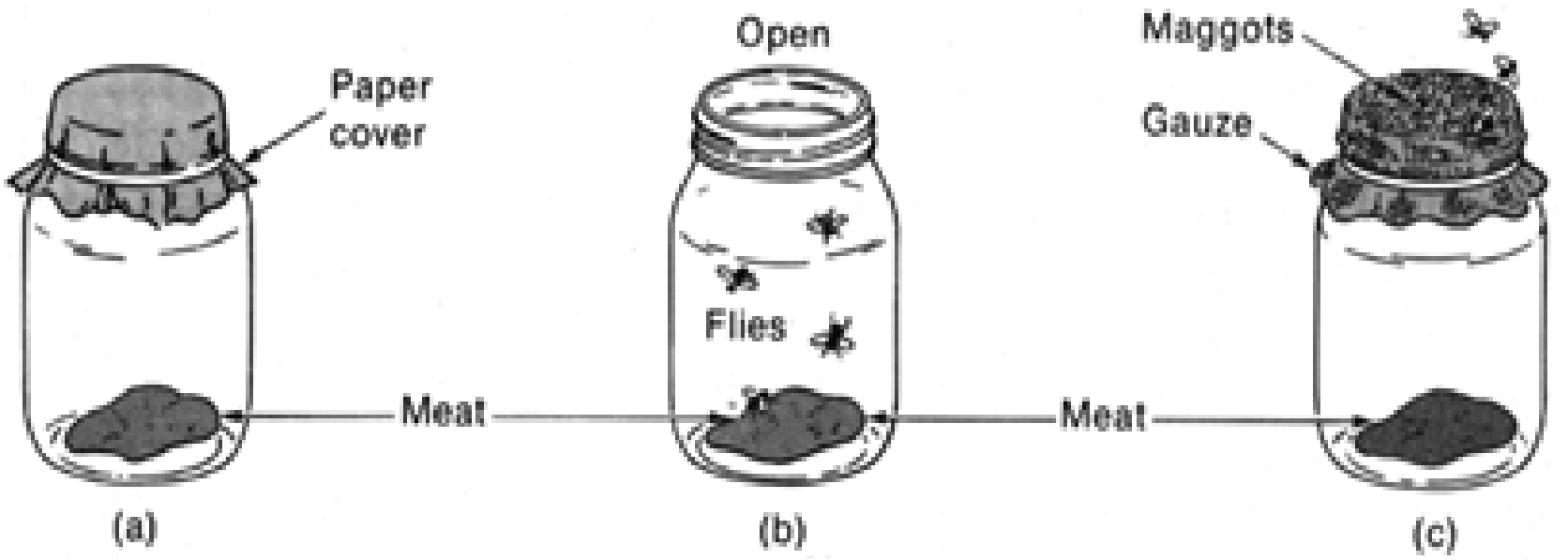
Abiogenesis VS Biogenesis

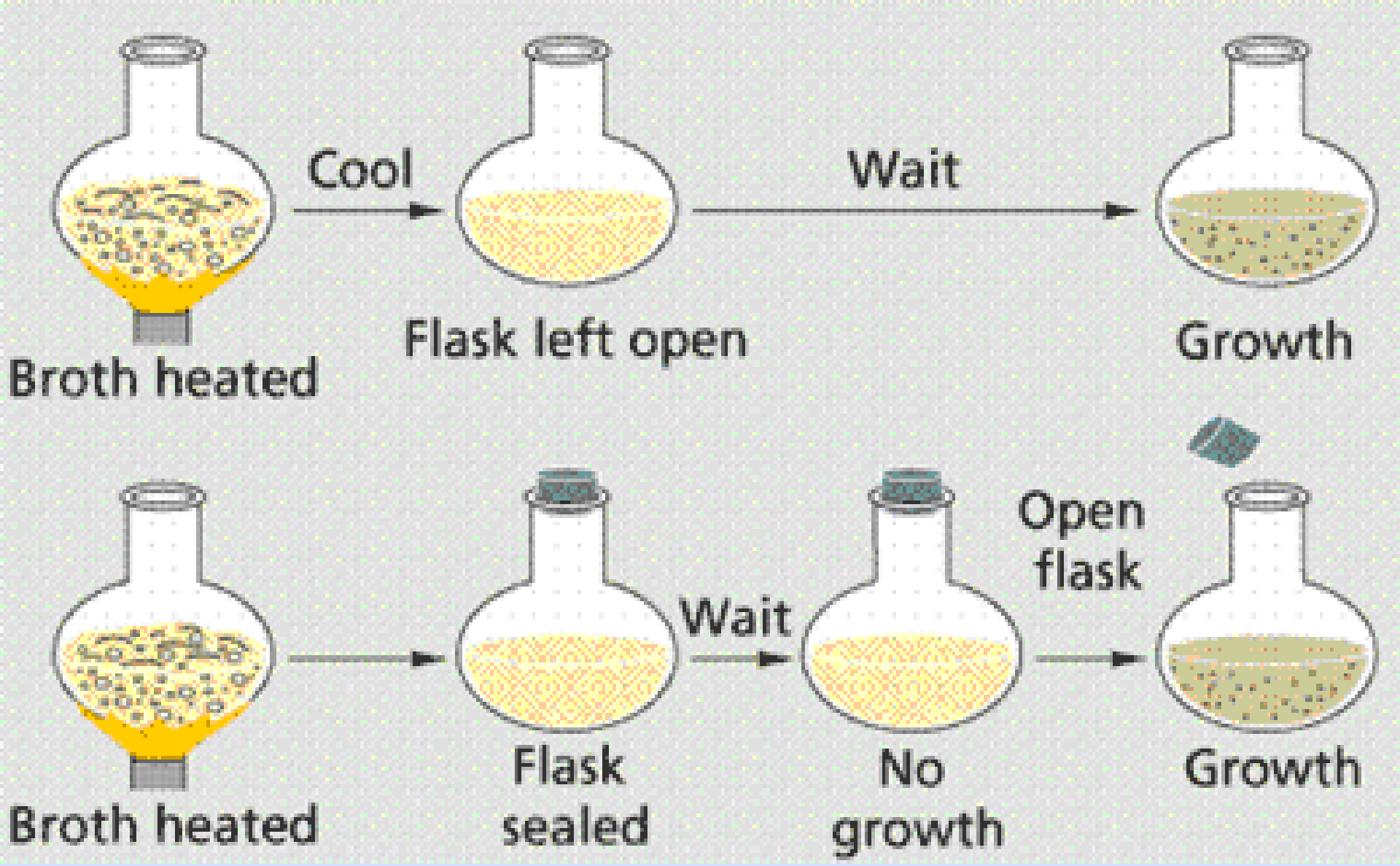
- ***Spontaneous generation / Abiogenesis***
  - **Aristoteles** (364 B.C)
  - *"The generation of some form of life from non living objects"*.
  - Had so many strong followers among the educated & elite class.
  - **Needham** (1749) : boiled meat & meat broth, following storage in covered flasks → spoilage

Abiogenesis VS Biogenesis

- ***Biogenesis***
  - **Francesco Redi** (1650) : fly maggot experiment
  - **Lazzaro Spallanzani** (1765) : heated broth theory & disprove Needham theory.
  - **Franz Schulze** (1830) : passing air through acid
  - **Theodore Schwann** (1838) : passing air through hot tubes
  - **Schroeder** & **Von Dusch** (1854) : cotton filter
  - **Louis Pasteur** (1858-1861) : swan neck flask
  - **John Tyndall** (1870) : Tyndall's (dust free) apparatus

Redi's Experiment





Spallanzani's Experiment

Louis Pasteur (1822-1895)

- Showed microbes caused fermentation and spoilage
- Disproved spontaneous generation of microorganisms
- Developed pasteurization
- Demonstrated what is now known as Germ Theory of Disease
- Developed a rabies vaccine

Pasteur's Swan Neck Experiment

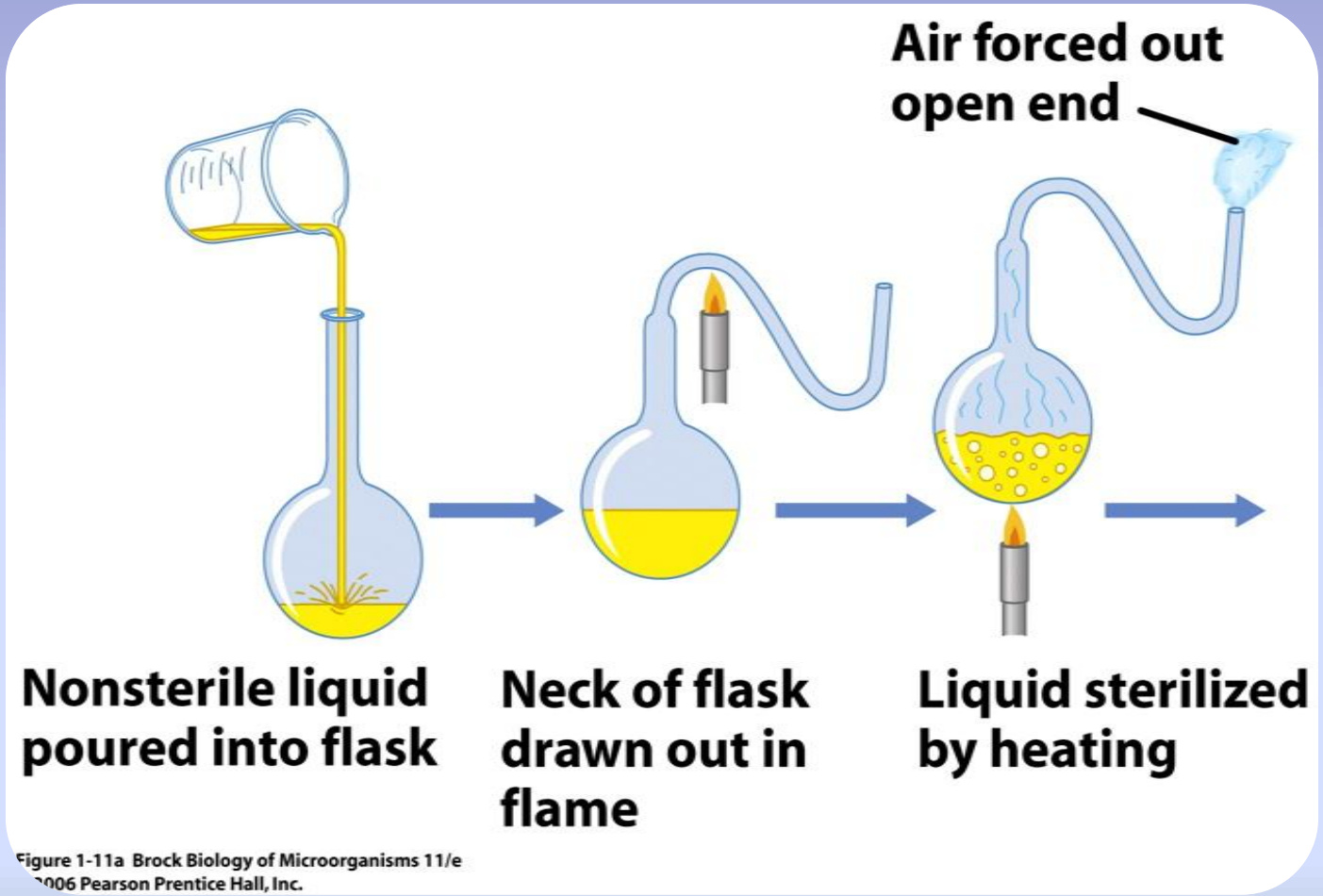


Figure 1-11a Brock Biology of Microorganisms 11/e
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Pasteur's Swan Neck Experiment

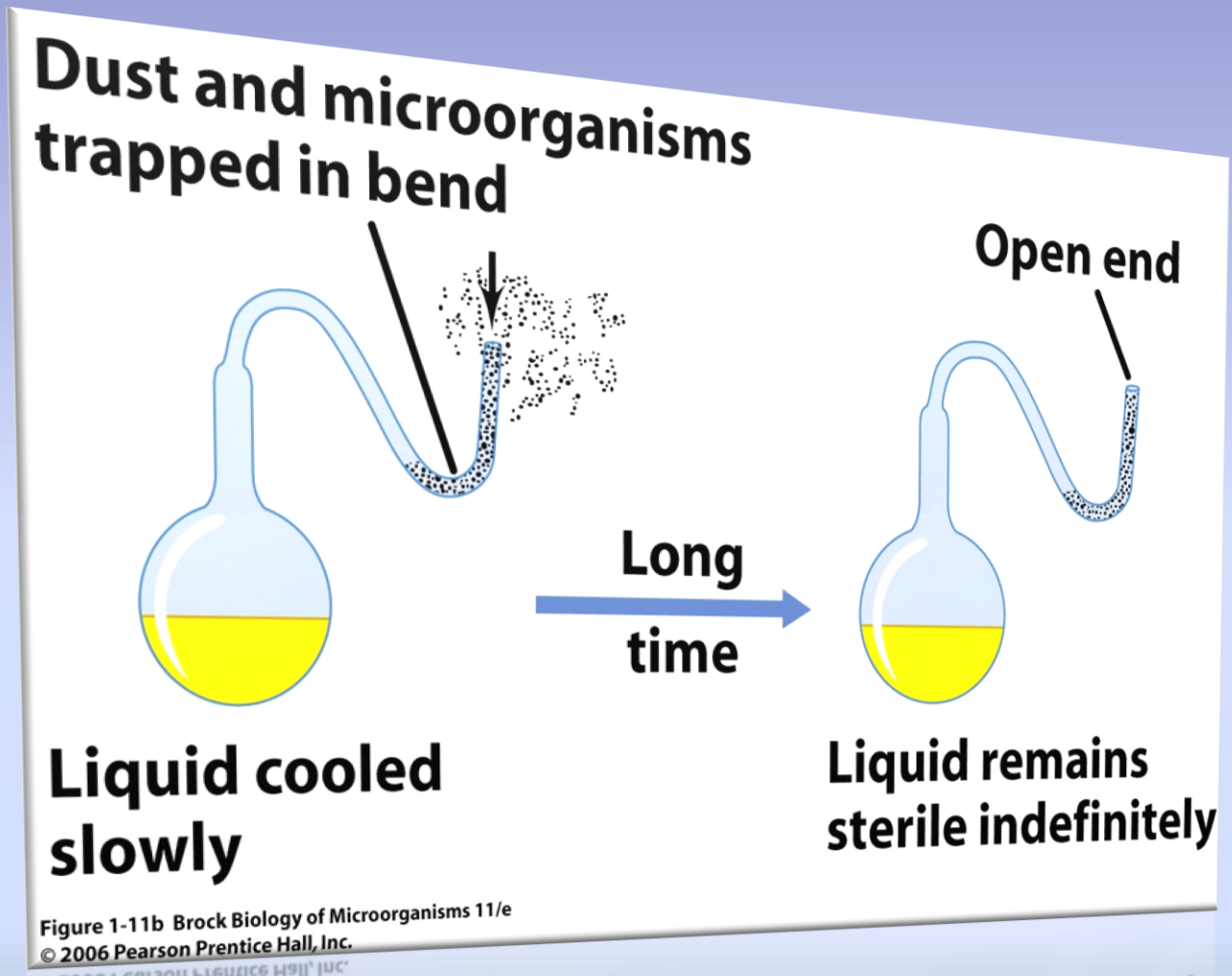
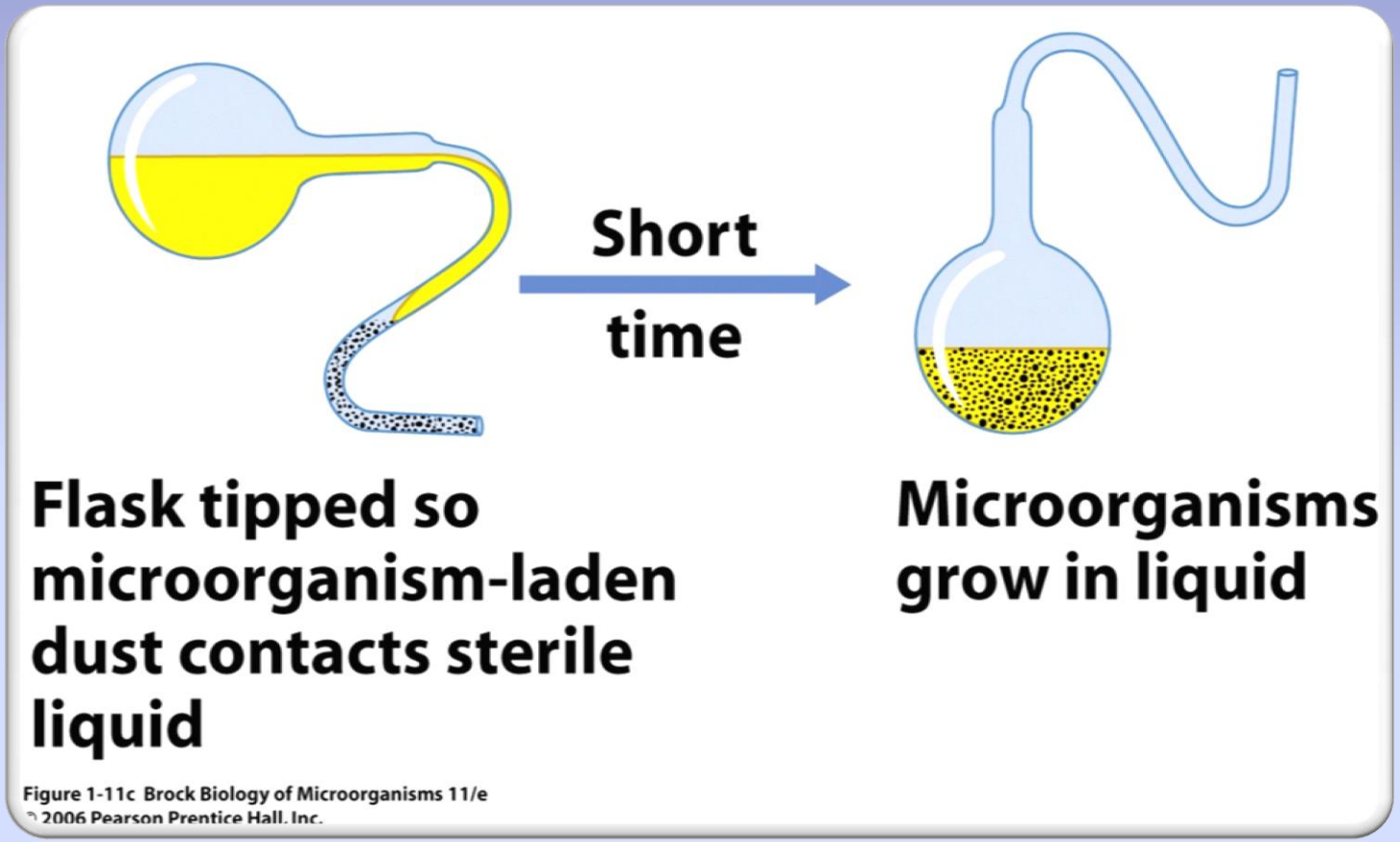


Figure 1-11b Brock Biology of Microorganisms 11/e

Pasteur's Swan Neck Experiment



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History: Pasteur's Conclusions

- The bended neck allowed air to enter the bottle and the liquid but trapped any particulates including microorganisms.
- No microbial growth as long as the liquid broth did not come in contact with the microbes.
- Hence air alone was not sufficient to generate life.

Discovery of Microorganisms

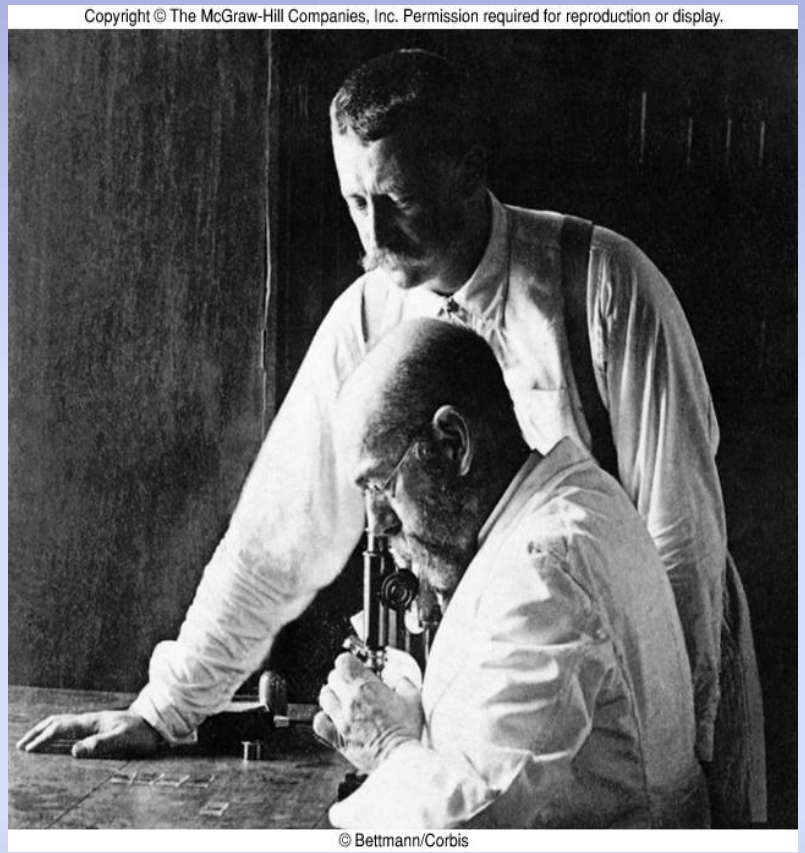
1838
- **Ehrenberg** : introduced the term of bacteria (16 species in 4 genera).

1843
- **Robert Koch** : Koch's Postulates

1875
- **Cohn** : discover that some bacteria produced spores.

1940
- Invention of the **electron microscope**

Robert Koch (1843-1910)



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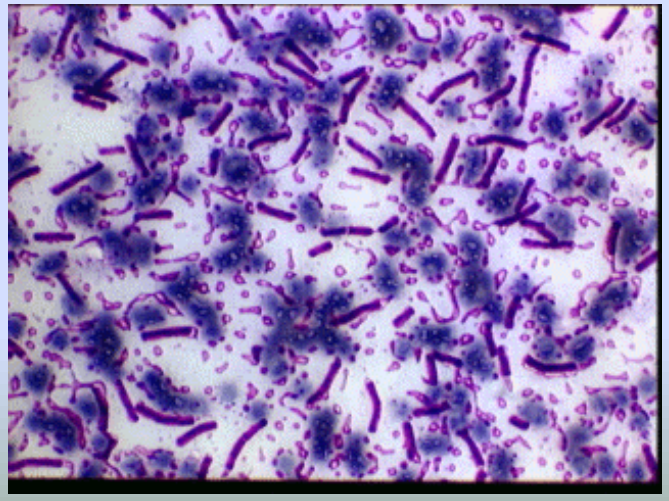
- Established **Koch's postulates** - a sequence of experimental steps that verified the germ theory
- Identified cause of anthrax, tubercolusis, and cholera
- Developed pure culture methods

History: Microorganisms Cause Disease

- Robert Koch developed a set of postulates to prove that a specific microorganism causes a specific disease.
  - *B. anthracis* causes anthrax
  - *M. tuberculosis* causes tuberculosis



Koch's Postulates

Determining the causative or **etiologic** agent of infectious disease:

- **Find evidence** of a particular microbe in every case of a **disease**.
- **Isolate that microbe** from an **infected subject** and cultivate it artificially in the laboratory.
- **Inoculate** a susceptible **healthy subject** with the laboratory isolate and observe the resultant disease.
- **Reisolate** the agent from this subject.

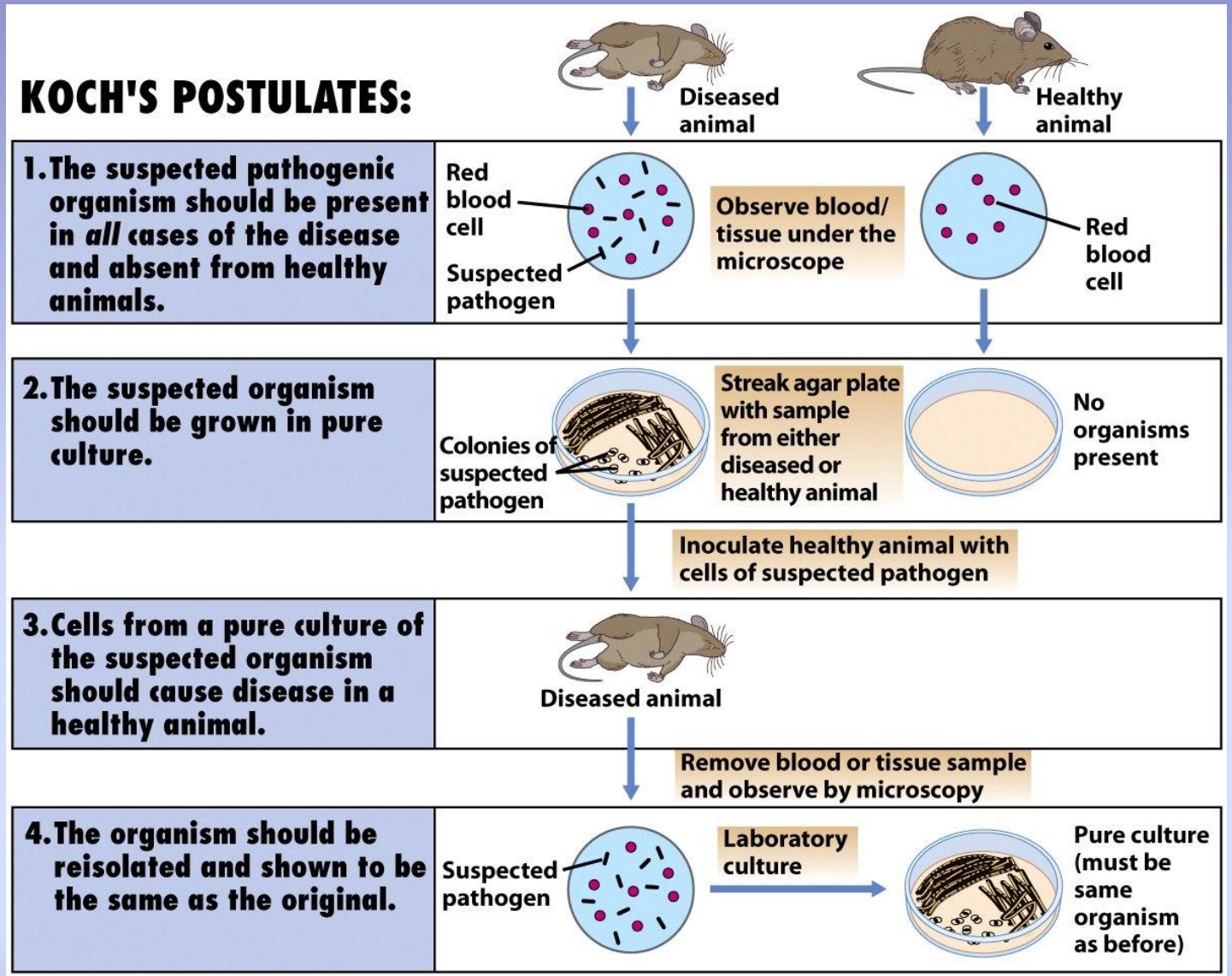


Figure 1-12 Brock Biology of Microorganisms 11/e

Robert Koch Theory

- Postulates – **Germ theory** (1876)
- Identified microbes that caused : **anthrax** (1876), **tuberculosis** (1882) and **cholera** (1883)
- Developed microbiological media & streak plates for **pure culture** (1881)

Germ Theory Of Disease

"The founding of disease causative agents and sepsis occurs when surgery and baby born time → development of medical microbiology"

- **Girolamo Fracastoro** (1530) : sheep *sifilis disease*
- **Edward Jenner** (1798) : smallpox vaccines
- **Agostino Bassi** (1835) : *Botytris f*ungi → silkworm
- **Oliver Wandell Holmes** (1843) : sanitation (CaCl2)
- **Joseph Lister** (1867) : aseptic methods (phenol)
- **Robert Koch** (1876) : organism causes diseases & isolation of Tuberculosis basil
- **Louis Pasteur** (1880 -1881) : anthrax vaccine
- **Paul Ehlrich** (1908) : chemotherapist
- **Alexander Fleming** (1929) : penicillin

Discovery of Spores and Sterilization

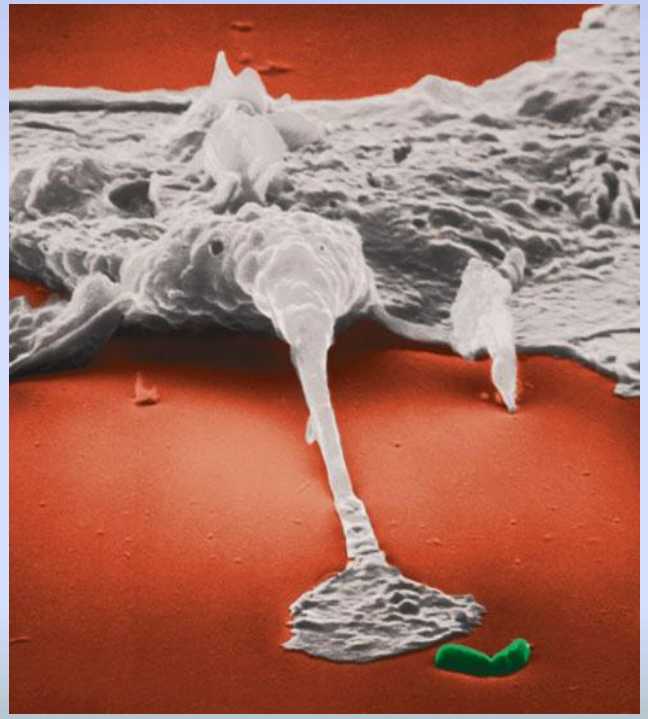
- **John Tyndall** and **Ferdinand Cohn** each demonstrated the presence of heat resistant forms of some microbes.
  - Cohn determined these forms to be **endospores**.
- **Sterility** requires the elimination of all life forms including endospores and viruses.

Development of Aseptic Techniques

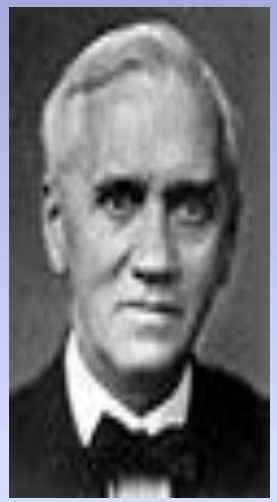
- **Dr. Oliver Wendell Holmes** – observed that mothers of home births had fewer infections than those who gave birth in hospital
- **Dr. Ignaz Semmelweis** – correlated infections with physicians coming directly from autopsy room to maternity ward
- **Joseph Lister** – introduced aseptic techniques reducing microbes in medical settings to prevent infections
  - involved disinfection of hands using chemicals prior to surgery
  - use of heat for sterilization

History: Host Defense against Microbes

- Ehrlich: Magic Bullet (antibodies)
- Metchnikoff: Phagocytosis
- Fleming: Lysozyme



History: Antimicrobial Drugs



Sir Alexander Fleming

Discovery of Penicillin

Pathogens and Germ Theory of Disease

- **Pathogens** – organism that cause disease
- Many diseases are caused by the growth of microbes in the body and not by sins, bad character, or poverty, etc.
- **Two major contributors:**
  1. Louis Pasteur
  2. Robert Koch

Modern Era of Microbiology

- Applied microbiology : agricultural, soil, marine
- Basic microbiology : microbial systems, biochemistry, genetics
- Molecular microbiology : biotechnology, genomics
- In the middle to latter part of the 20th century, basic and applied microbiology worked hand in hand to usher in the current era of **molecular microbiology**.

Taxonomy

- **Taxonomy**: organizing, classifying, and naming living things
  - Formal system originated by Carl von Linné
- Concerned with:
  - **Classification** – orderly arrangement of organisms into groups
  - **Nomenclature** – assigning names
  - **Identification** – determining and recording traits of organisms for placement into taxonomic schemes

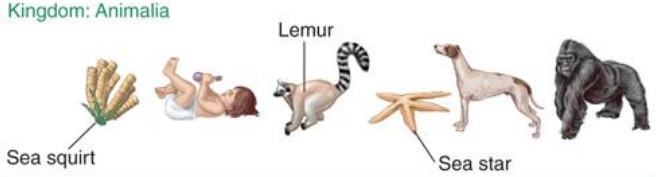
Levels of Classification

- **Domain - Archaea, Bacteria & Eukarya**
- **Kingdom – 5**
  - **Monera**
  - **Plantae**
  - **Protista**
  - **Animalia**
  - **Fungi**
- Phylum or Division
- Class
- Order
- Family
- **Genus**
- **species**

Sample Taxonomy

Domain: Eukarya (All eukaryotic organisms)

Kingdom: Animalia



Phylum: Chordata

Class: Mammalia

Order: Primates

Family: Hominoidea

Genus: *Homo*

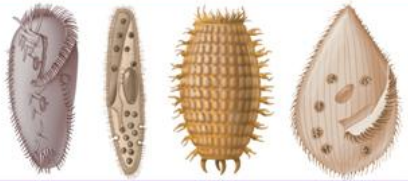
Species: *sapiens*

(a)

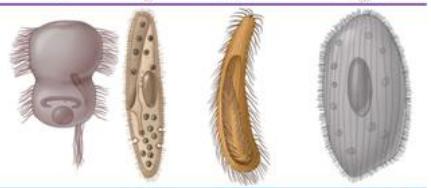
Domain: Eukarya (All eukaryotic organisms)

Kingdom: Protista
Includes protozoa and algae

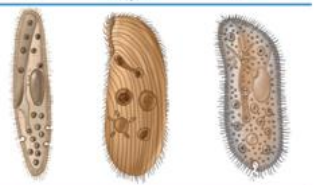
Phylum: Ciliophora
Only protozoa with cilia



Class: Hymenostomea
Single cells with regular rows of cilia; rapid swimmers



Order: Hymenostomatida
Elongate oval cells with cilia in the oral cavity



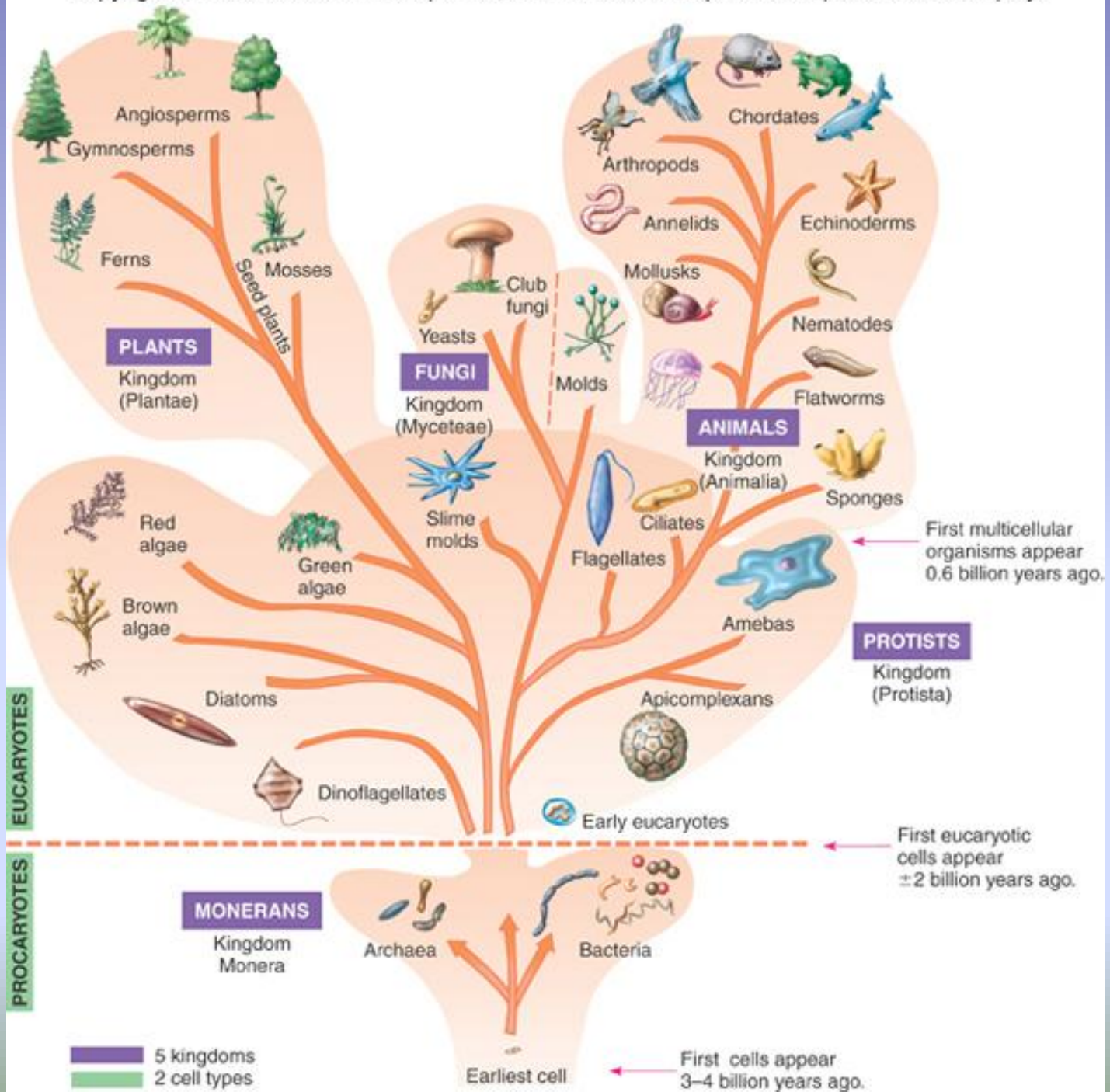
Family: Parameciidae
Cells rotate while swimming and have oral grooves.

Genus: *Paramecium*
Pointed, cigar-shaped cells with macronuclei and micronuclei

Species: *Caudatum*
Cells cylindrical, long, and pointed at one end

(b)

Fig. 1.14



The Origin and Evolution of Microorganisms

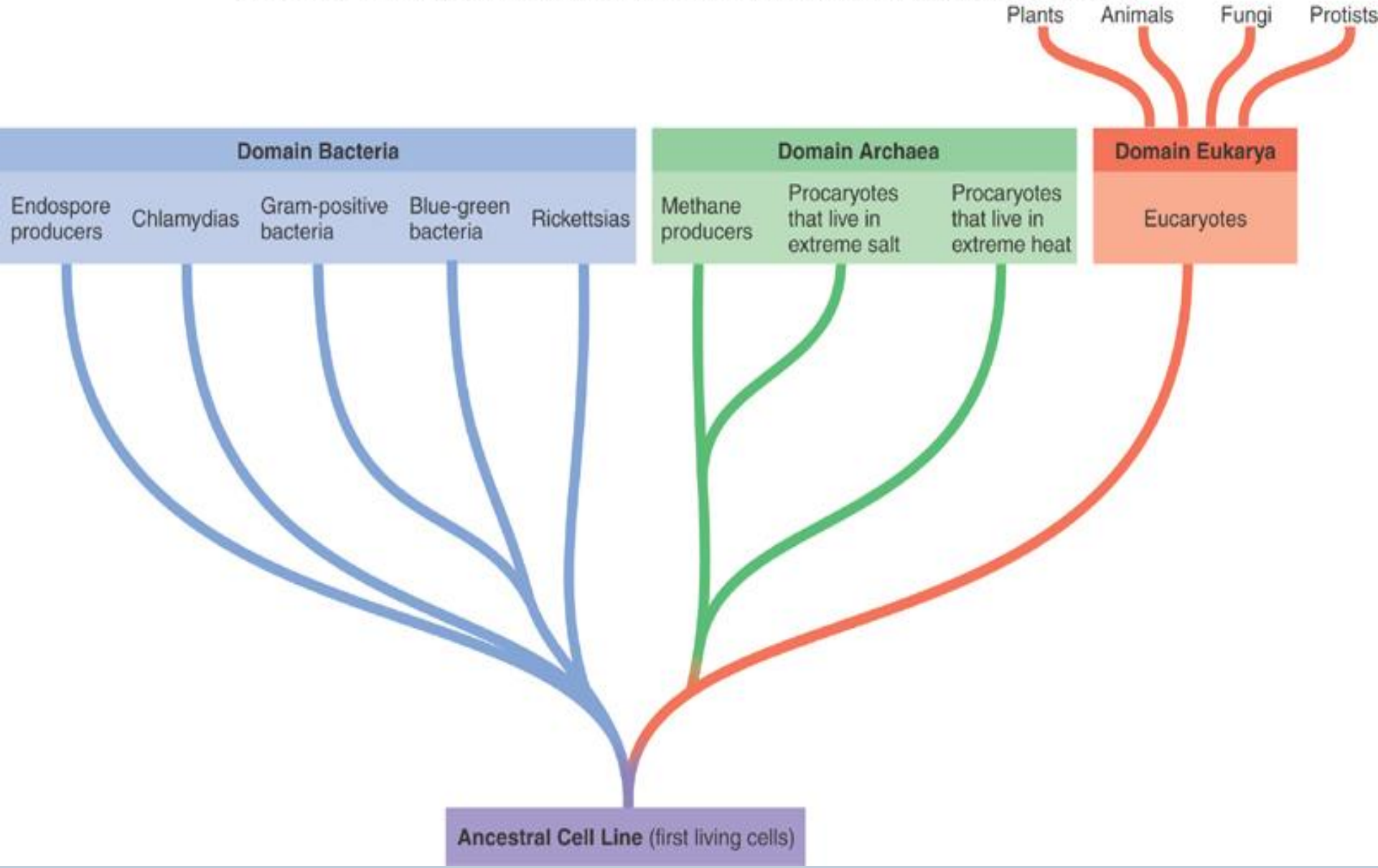
- **Phylogeny**: natural and evolutionary relatedness between groups of organisms
- **Evolution**
  - All new species originate from preexisting species
  - Closely related organism have similar features because they evolved from common ancestral forms
  - Changes favoring survival are retained and less beneficial changes are lost.
- Evolution usually progresses toward greater complexity

The Origin and Evolution of Microorganisms

- Evolution Is Supported by the Study of:
  - Morphology (Shape)
  - Physiology (Function)
  - Genetics (Inheritance)
    - In particular new techniques in molecular biology include study of genes
    - Both structure and function
    - Ribosomal RNA (rRNA) provide a living record of evolutionary history of an organism.
    - Consider mitochondria

3 Domains

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



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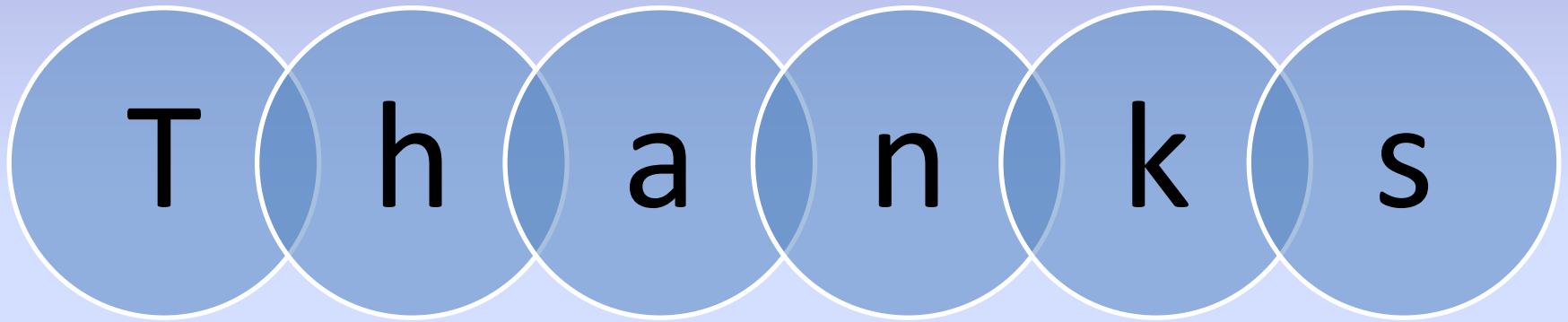
- Talaro KP. 2012. *Foundation in Microbiology 6th Edition*. The McGraw Hill Companies.
- Ray B. 1996. *Fundamental Food Microbiology*. CRC Press. Boca Raton.
- Pelczar and Chan. 1988. Elements of Microbiology. McGraw Hill Book Company.
- Tortora *et al*.
- Scientific articles from internet/website

INDIVIDUAL ASSIGNMENT

- Mention and explain the weakness of Koch's Postulates?
- What do you know about Griffith Theory? Explain briefly!
- Explain immunity theory by Ehrlich!
- Find and summarize one microbiological scientist and his/her discoveries! (max 1 page of summary)
- The assignment must be done by hand writing and submited in next week (week-2)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