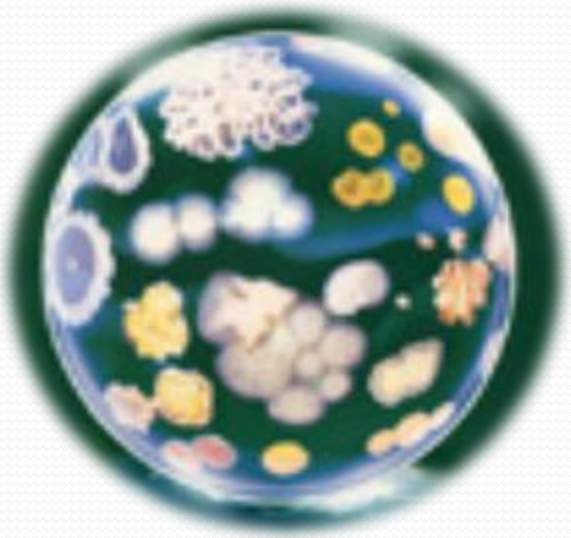
Medical Bacteriology

By: Dr: M. Marashi

Teacher

- Dr. Marashi
  - BS. Microbiology from Isfahan University
  - MS. Medical Microbiology from Tehran University
  - Ph.D Medical Bacteriology from Isfahan University
  - Post-Doc oral microbiology from Malmo University, Sweden

نگاهی به دنیای میکروبی

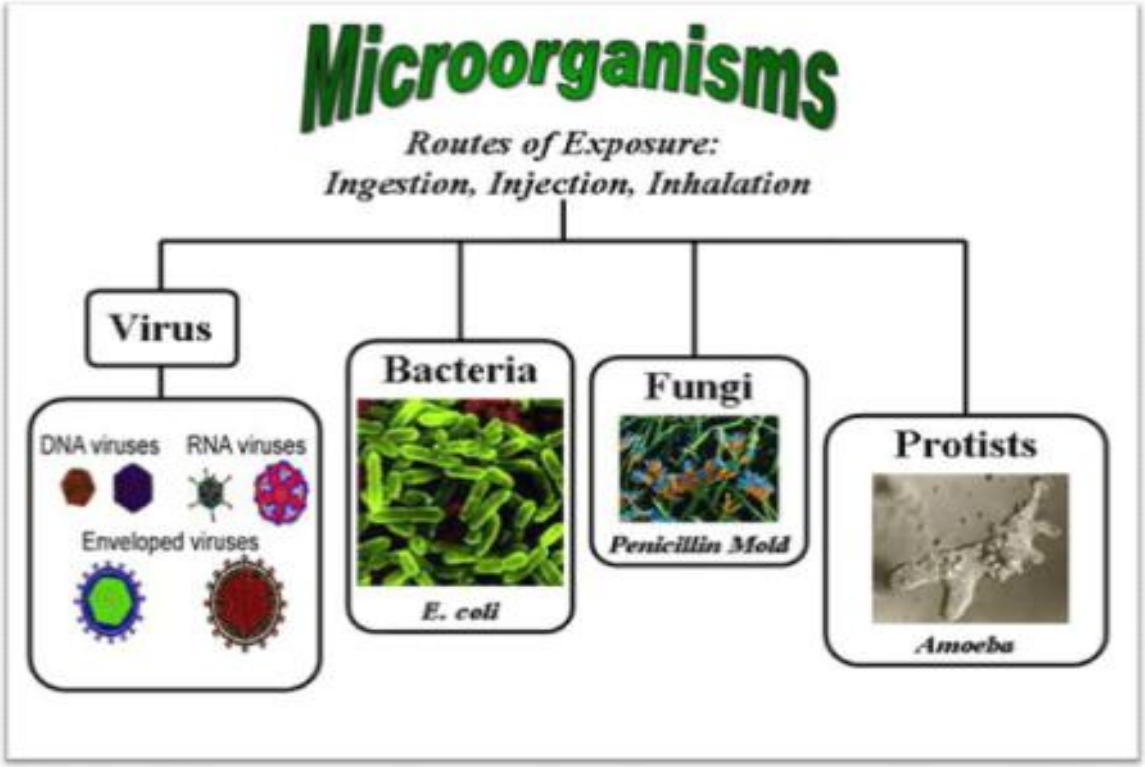


میکروبها قدیمی ترین فرم حیات بر روی کره زمین هستند. فسیلهای میکروبی به ۳/۵ میلیارد سال پیش بر می گردد که کره خاکی با اقیانوس ها پوشیده شده بود.

اقیانوسهایی با دمای در حدود نقطه جوش. این زمان یعنی صدها میلیون سال قبل از اینکه دایناسورها زمین را در نوردند!

Microbiology; a fresh science

- Microbiology
  - Bacteriology
  - Virology
  - Mycology
  - Protozeology



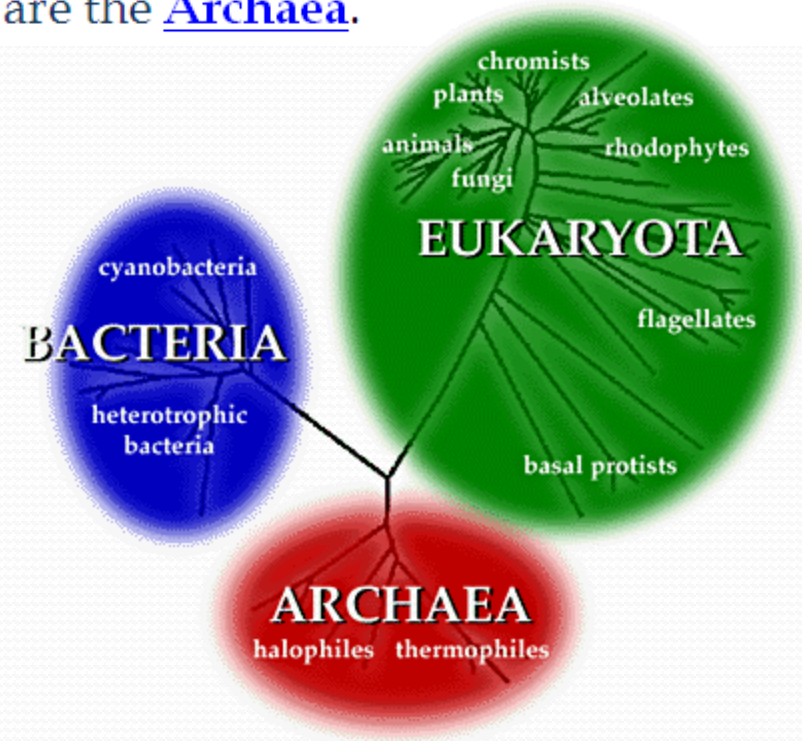
Microorganisms

- Bacteria
- Viruses
  - Bacteriophage
- Prions


BACTERIOPHAGE
VIRUSES

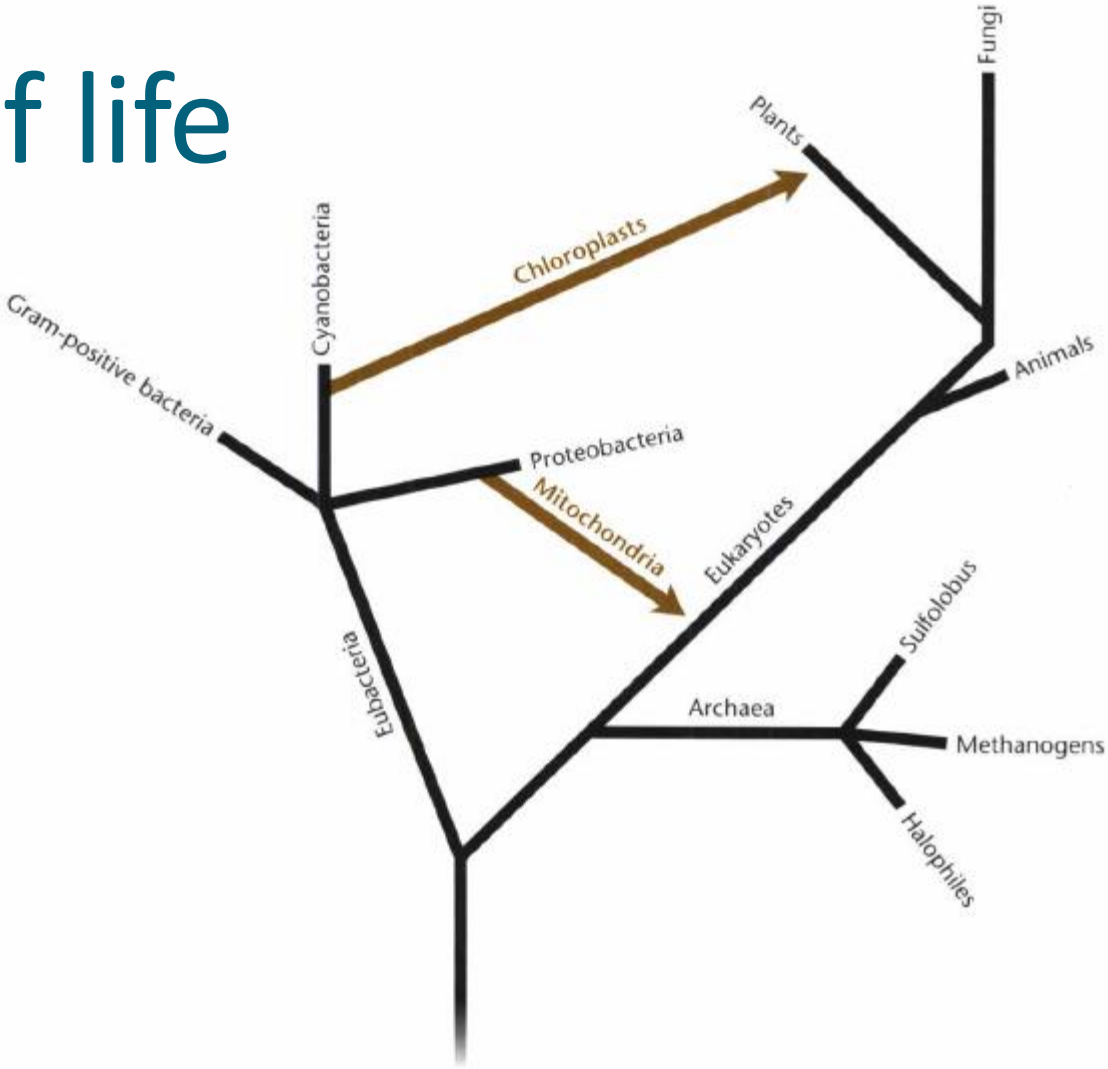
BACTERIA

Bacteria (singular: **bacterium**) are a major group of living organisms. The term "bacteria" (singular: **bacterium**) has variously applied to all prokaryotes or to a major group of them, otherwise called the **eubacteria**, depending on ideas about their relationships. Here, ***bacteria*** is used specifically to refer to the eubacteria. Another major group of bacteria are the **Archaea**.



The study of bacteria is known as ***bacteriology***, a subfield of microbiology.

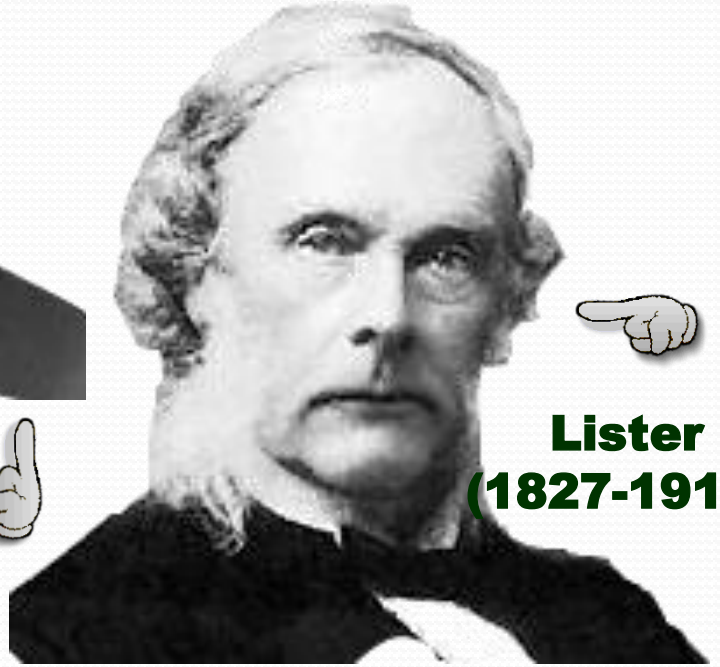
Tree of life


Fungi
Plants
Chloroplasts
Cyanobacteria
Gram-positive bacteria
Animals
Proteobacteria
Mitochondria
Eukaryotes
Sulfolobus
Eubacteria
Archaea
Methanogens
Halophiles

Florence Nightingale (1820-1910)

Semmelweis (1818-65)

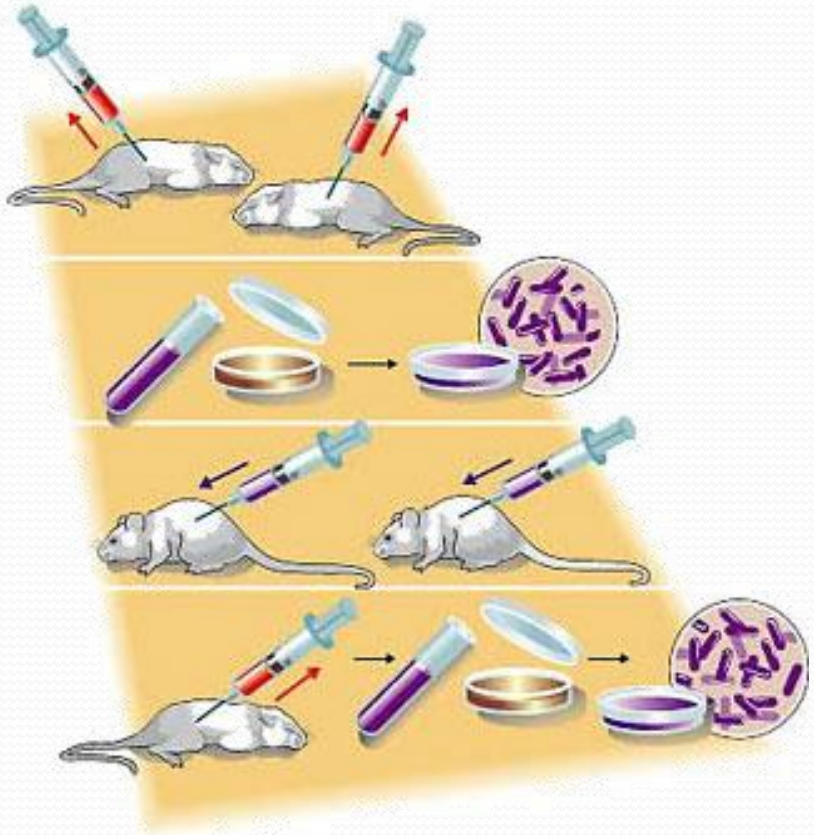
Pasteur (1822-95)



Lister (1827-1912)

KOCH'S POSTULATES

In Koch's postulates, he set out criteria to test if an organism is the cause of a disease; these postulates are still used today.



Applied Bacteriology

- Medical Bacteriology
- Pharmaceutical Bacteriology
- Industrial Bacteriology
- Microbial biotechnology
- Food and Dairy Bacteriology
- Agricultural Bacteriology
- Veterinary Bacteriology
- Environmental Bacteriology
- Water Bacteriology(or Aquatic Bacteriology)

BACTERIA

Prokaryotes
Eukaryotes

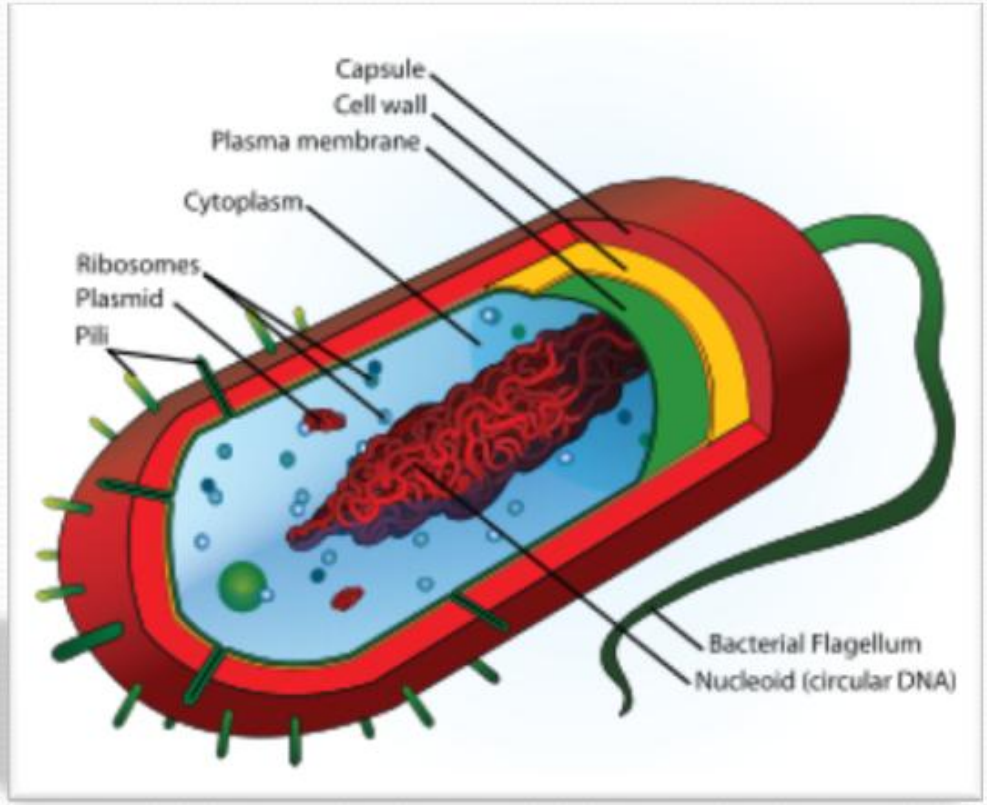


Table 1.3 Major differentiating characteristics of prokaryotes and eukaryotes

Characteristic	Prokaryote	Eukaryote
Nuclear structure and function		
Nucleus with membrane	No	Yes
Chromosomes	One	Two or more
Mitosis	No	Yes
Sexual reproduction	Rare; only part of genome involved	Common; all chromosomes involved
Meiosis	No	Yes
Cytoplasmic structures		
Mitochondria	No	Yes[a]
Chloroplasts	No	Yes (if photosynthetic)
Ribosomes	70S	80S[b]
Typical cell volume	<5 μm^3	>5 μm^3

[a]A few lack mitochondria.
[b]Some rare, primitive eukaryotic microorganisms have 70S ribosomes.

Table 1.2 Major differentiating characteristics of the three domains of life

	Bacteria	*Archaea*	*Eucarya*
Nuclear membrane	No	No	Yes
Plastids	No	No	Yes
Peptidoglycan cell walls	Yes[a]	No	No
Membrane lipids	Ester-linked	Ether-linked	Ester-linked
Ribosome size	70S	70S	80S

[a]Three bacterial groups, the chlamydia, planctomycetes, and mycoplasmas, lack cell wall peptidoglycan (the structure of this material is discussed in Chapter 4).

Medical Bacteriology

- History
- Classification
    - Kingdom
    - Division
    - Sub-division
    - Order
    - Family
    - Genus
    - Species

Neisseria meningitidis 053442

Taxonomy ID: 374833
Rank: no rank
Genetic code: Translation table 11 (Bacterial and Plant Plastid)
Other names:
equivalent name: **Neisseria meningitidis strain 053442**
equivalent name: **Neisseria meningitidis str. 053442**

Kingdom — **Bacteria**

Phylum / **Divisions** — **Proteobacteria**

Class — **Betaproteobacteria**

Order — **Neisseriales**

Family — **Neisseriaceae**

Genus — **Neisseria**

Species — **Neisseria meningitidis**

DANGEROUS

Others are notorious for causing diseases, creating hazardous substances, c
osing some threat to other living things

ANCIENT

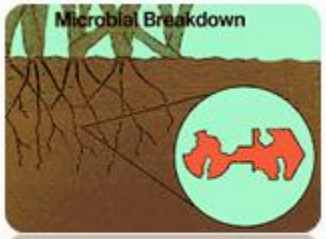
Many microorganisms have captured the public interest recently because o
fascination related to their great age

STRANGE

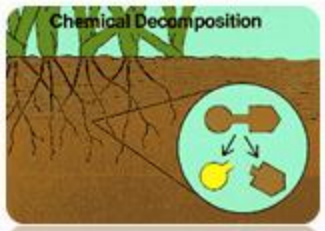
Some microbes grab attention because of their immense size, bizarre diet, or
other unusual characteristics

HEROIC

Some microbes are newsworthy because they help fight diseases, control
pollution, or perform some other useful function


Microbial Breakdown


سودمند


Chemical Decomposition


BIOINSECT
Bacillus thuringiensis, variedades :
tenebrionis / kurstaki / aizawai / israelensis

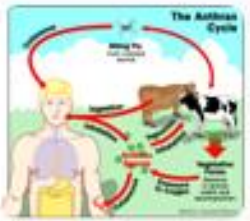

Dairy Farmers
Foodservice


Coca-Cola


Food
BESTFOODS
Hormel
VONS
General Mills
Albertsons
Kroger
armour


2X
Tide
Erythromycin 400


theme HOSPITAL


The Asthma Cycle

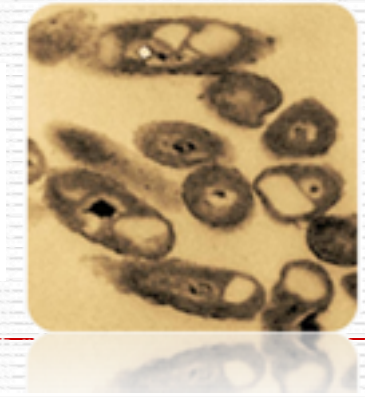

زیان آور

Slick Solution: How Microbes Will Clean Up the Deepwater Horizon Oil Spill

Bacteria and other microbes are the only thing that will ultimately clean up the ongoing oil spill in the Gulf of Mexico

By David Biello | May 25, 2010 | 38

میکروبهای نفت خوار



MIGHTY MICROBES: Tiny bacteria, such as Alcanivorax borkumensis pictured here, will ultimately clean up the ongoing Deepwater Horizon oil spill in the Gulf of Mexico.
Image: Courtesy of Heimholtz Center for Infection Research (HZI)

2010

نجات بخش

April 20, 2010

nature International weekly journal of science

Nature **407**, 897-900 (19 October 2000) | doi:10.1038/35038060; Received 15 November 1999; Accepted 4 July 2000

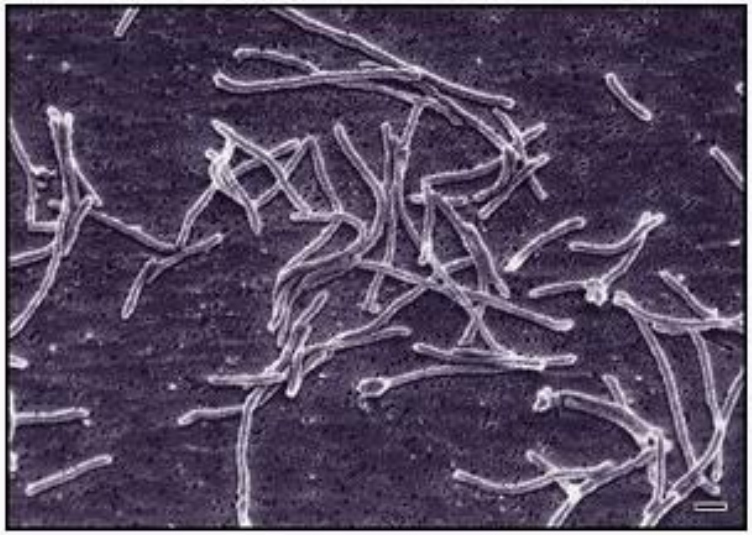
Isolation of a 250 million-year-old halotolerant bacterium from a primary salt crystal

Russell H. Vreeland[1], William D. Rosenzweig[1] & Dennis W. Powers[2]

1. Department of Biology, West Chester University, West Chester, Pennsylvania 19383 , USA
2. Consulting Geologist, Box 87, Anthony, Texas 79821, USA

Bacillus Sphaericus

Thermus aquaticus



Scientific classification

Kingdom:	Bacteria
Phylum:	Deinococcus-Thermus
Class:	Deinococci
Order:	Thermales
Genus:	*Thermus*
Species:	***T. aquaticus***

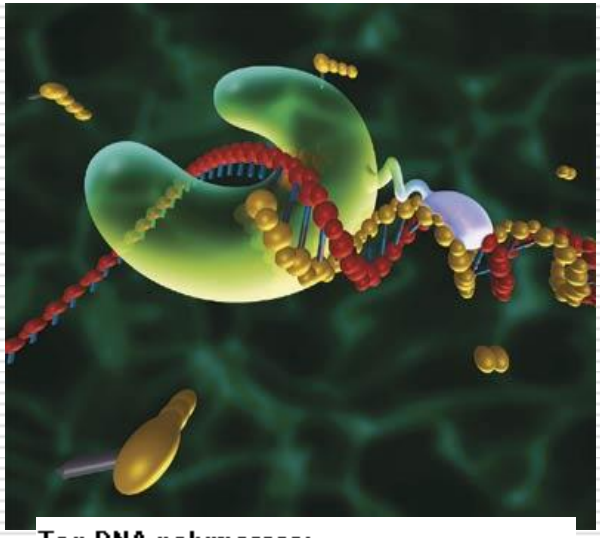
Binomial name

Thermus aquaticus

Brock & Freeze, 1969

THERMUS AQUATICUS

***Thermus aquaticus*is the source of the enzyme taq polymerase used in the polymerase chain reaction, PCR., The bacterium has an optimum temperature for growth of 70 degrees**



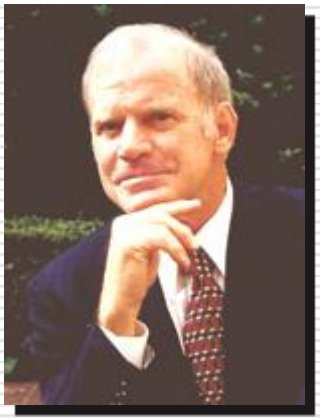
Taq DNA polymerase:

a thermostable (75-80^{0}C) DNA polymerase from hot springs and hydrothermal vents bacteria *Thermus aquaticus*.

FINDING ARCHAEA

The **hot springs** of Yellowstone National Park, USA, were among the first places Archaea were discovered. At left is Octopus Spring, and at right is Obsidian Pool.

کری مولیس: معمار بزرگ تکثیر ژن



Kary Mullis

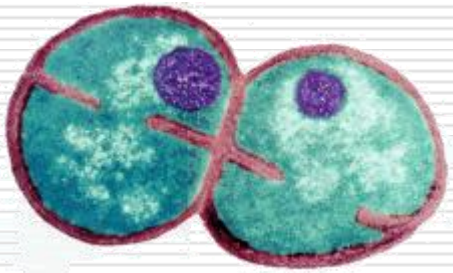
فروش اختراع او یعنی سیستم تکثیر ژن یا PCR ۳۰ میلیارد دلار

نصیب کمپانی بیوتکنولوژی Cetus در کالیفرنیا نمود و ۱۰/۰۰۰

دلار نصیب او!

PCR

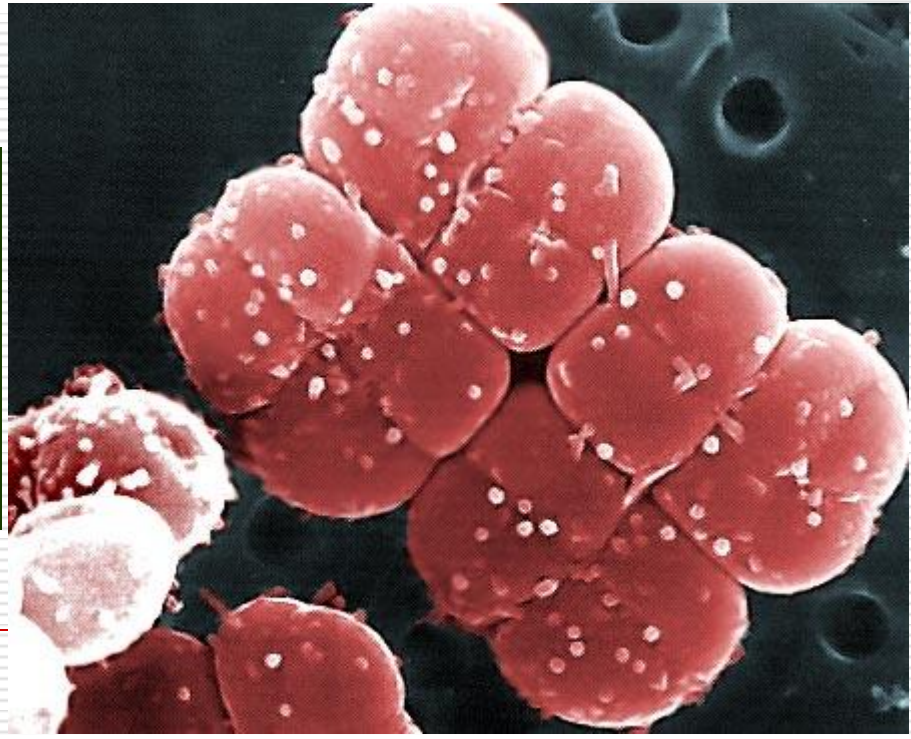
Deinococcus radiodurans



There's even a species of bacteria—*Deinococcus radiodurans*—that can withstand blasts of radiation 1,000 times greater than would kill a human being.

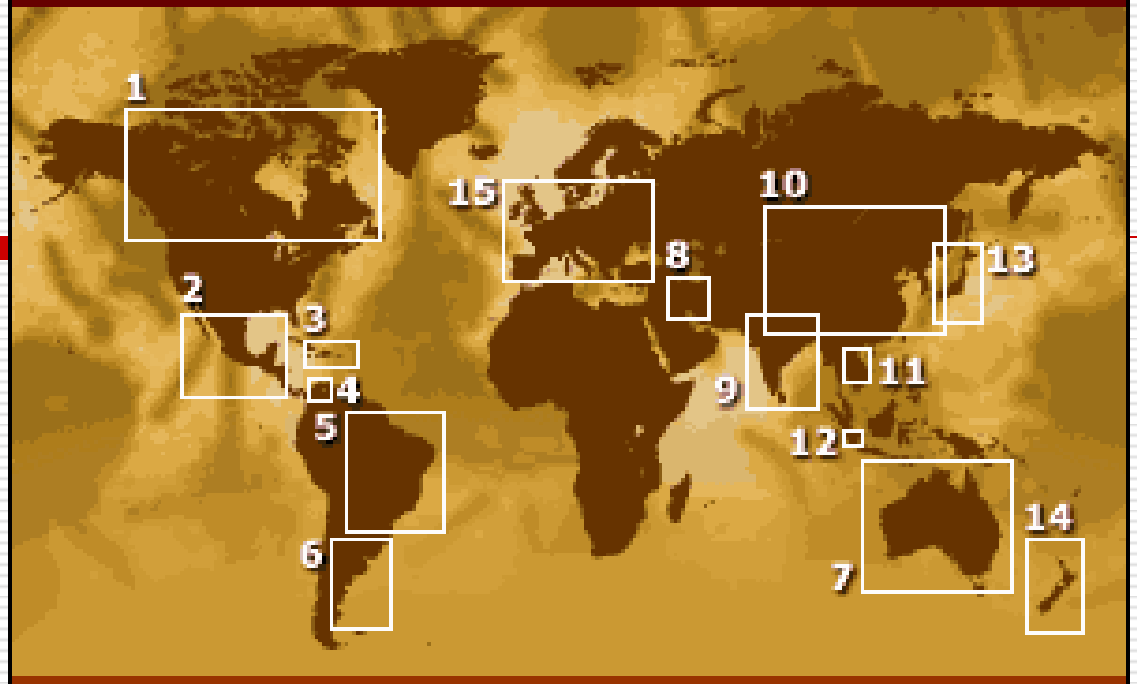
The picture opposite is an electron micrograph of the extraordinary bacterium *Deinococcus radiodurans*, which can not only withstand devastating levels of radiation (both ionising and ultraviolet), but can also resist horribly genotoxic chemicals such as concentrated acids, and oxidative damage (those free radicals you hear about...)

[Some strains are able to withstand up to 5 million rads of gamma radiation, higher than quoted on the card.]



Bioterrorism

RESEARCH FACILITIES STORING ANTHRAX

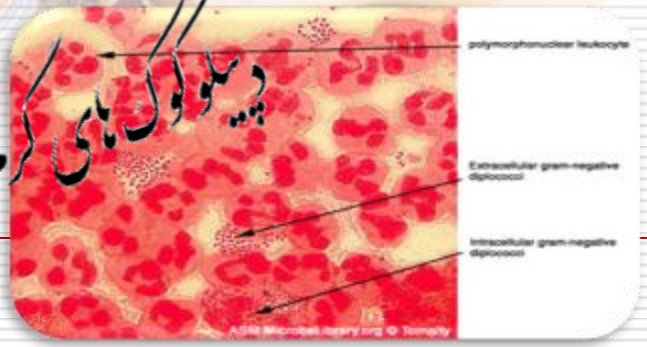


		No. of stores			No. of stores
1	Canada	1	13	Japan	3
2	Mexico	3	14	New Zealand	1
3	Cuba	1	15	UK	2
4	Venezula	1		France	1
5	Brazil	6		Switzerland	1
6	Argentina	3		Italy	1
7	Australia	5		Turkey	1
8	Iran	1		Czech Rep	2
9	India	2		Poland	1
10	China	2		Hungary	2
11	Thailand	3		Bulgaria	1
12	Singapore	1		Germany	1

FBI agents check for anthrax contamination in 2001

عصر آنتی بیوتیک ها

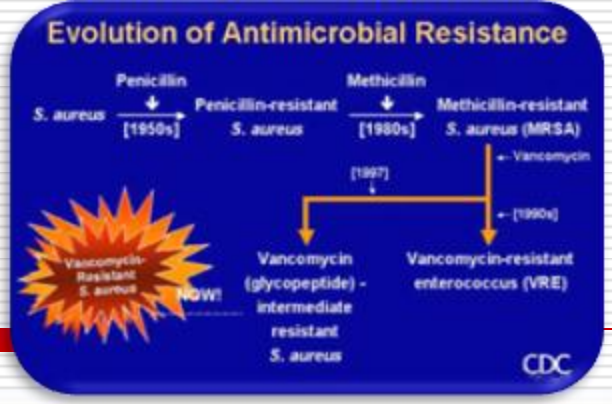
مننژیت قاتلی بیرحم

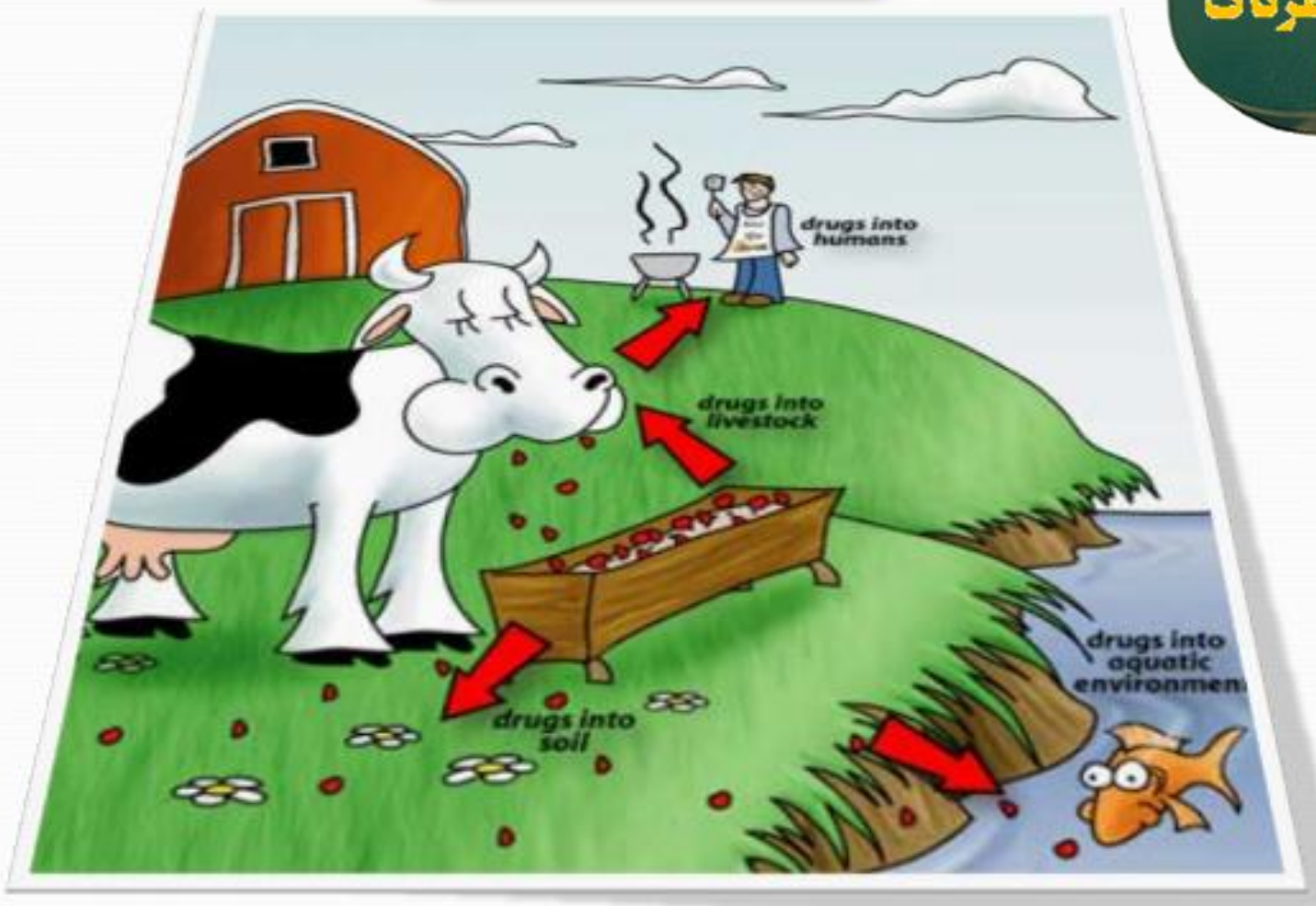


دیپلوکوک های گرم منفی داخل و خارج سلولی

نایسریا

پیدایش مقاومت میکروبی





آنفولانزای پرندگان

سل مقاوم به‌دارو

استافیلوکوک مقاوم به وانکومایسین

اشرشیا کلی O157:H07

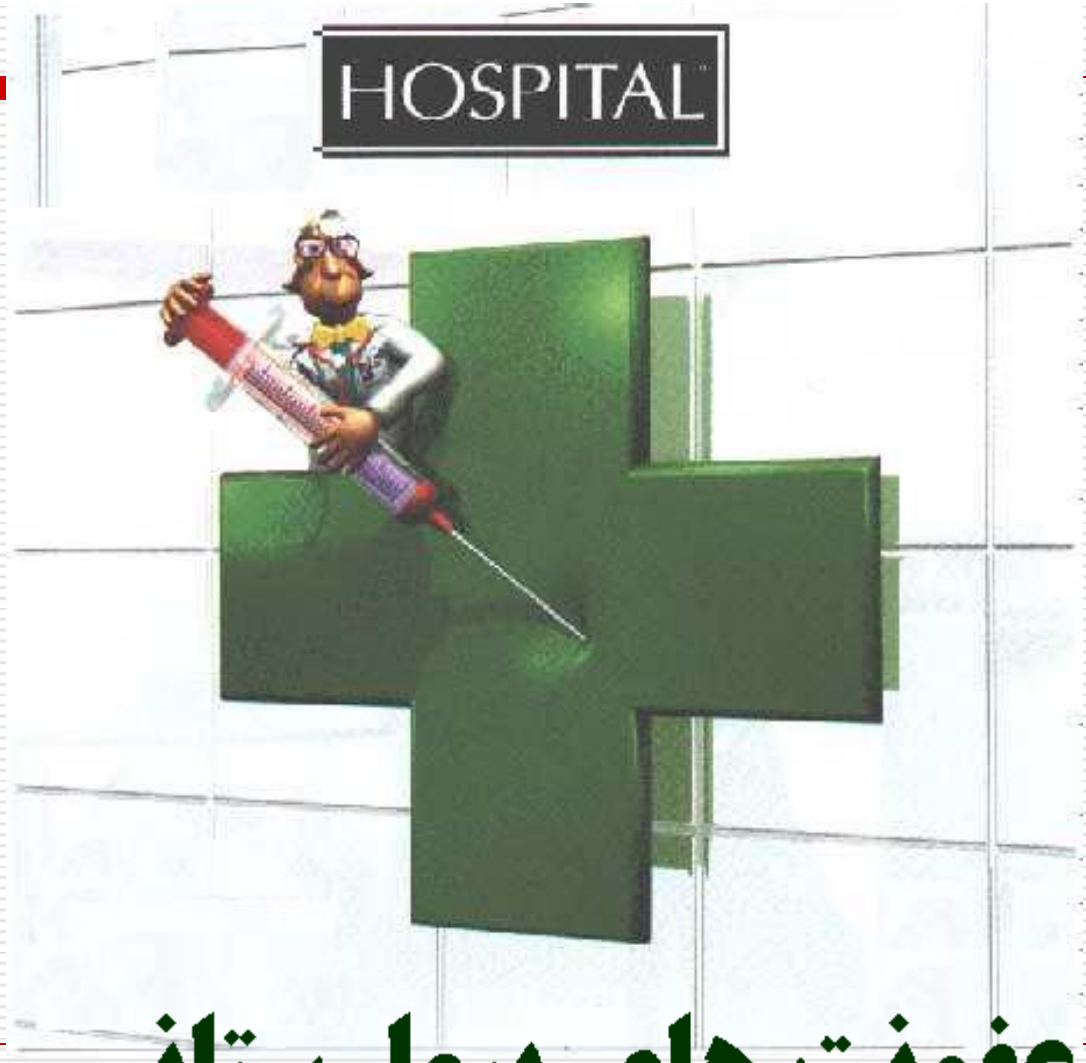
هپاتیت C

ایدز

مالاریا مقاوم به دارو

خطرناک

Nosocomial infections



خطرناک

عفونت های بیمارستانی

The Opponent – Hospital Infections

The procedure was a success, but ...

Hospital infections affect 2 million patients, leading to 58,000 deaths and costing $4.5 billion annually

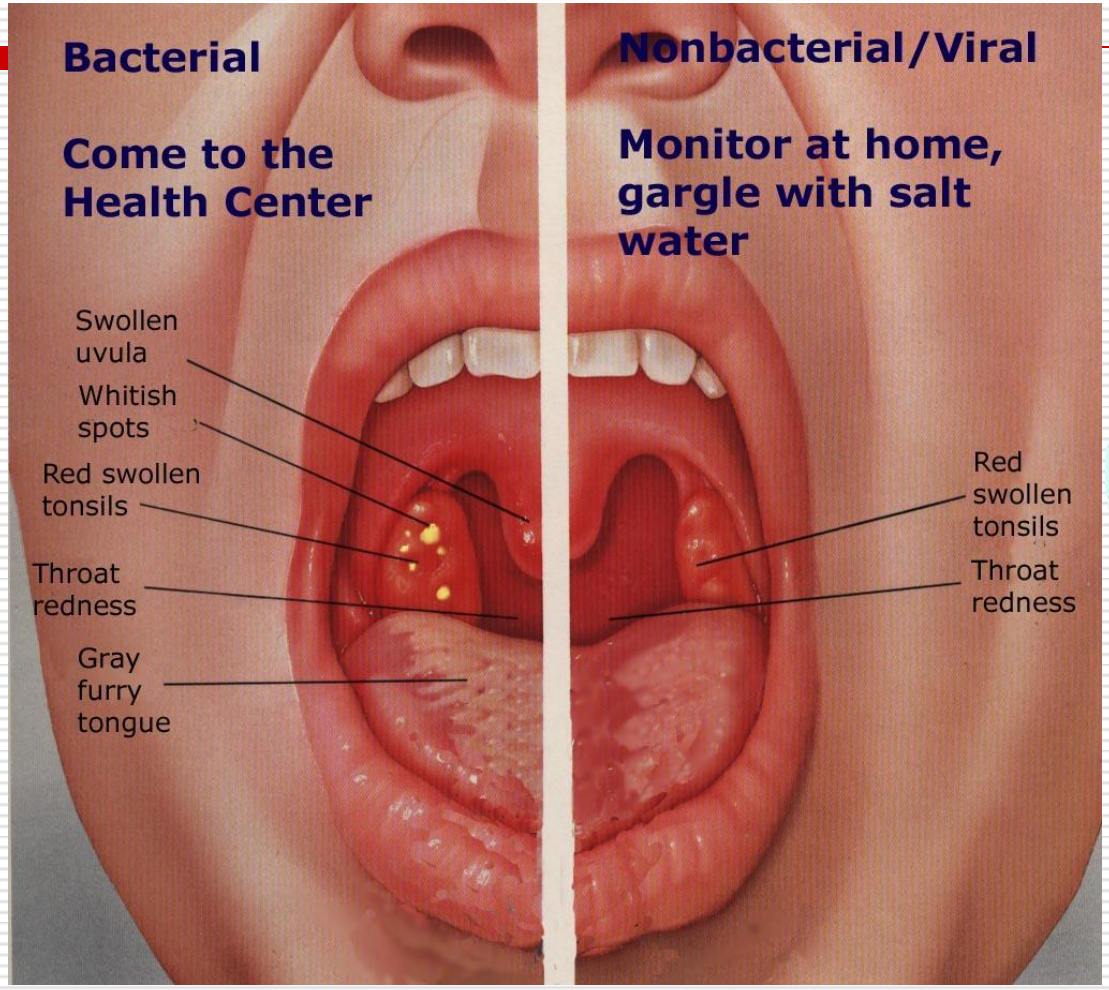
Washington

BJC HEALTH SYSTEM

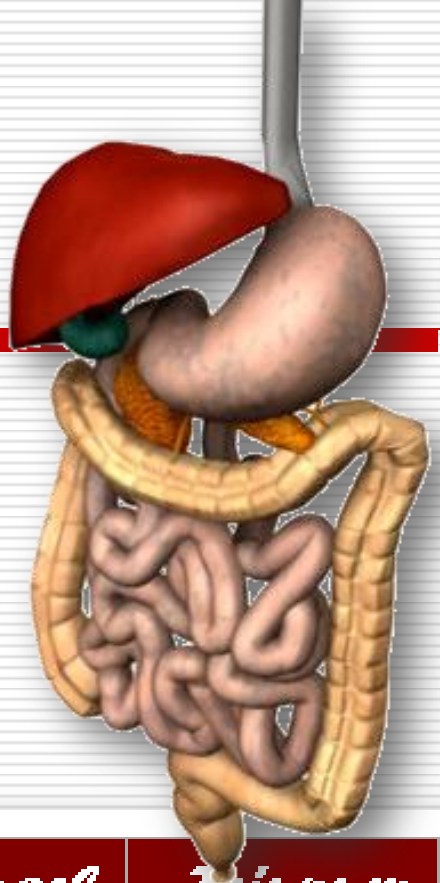
فلور طبیعی پوست

در هر سانتی متر مربع پوست در حدود 10^2 تا 10^4 ارگانیسم وجود دارد.

۴۰۰ تا ۸۰۰ گونه باکتریایی در ناحیه دهان ساکن می باشند.



فلور طبیعی مجرای گوارشی



	Stomach	Jejunum	Ileum	Colon
Viable Bacterial g	$0\text{-}10^3$	$0\text{-}10^9$	$10^0\text{-}10^5$	$10^{10}\text{-}10^{12}$
pH	3.0	6.0-7.0	>7.5	6.8-7.3

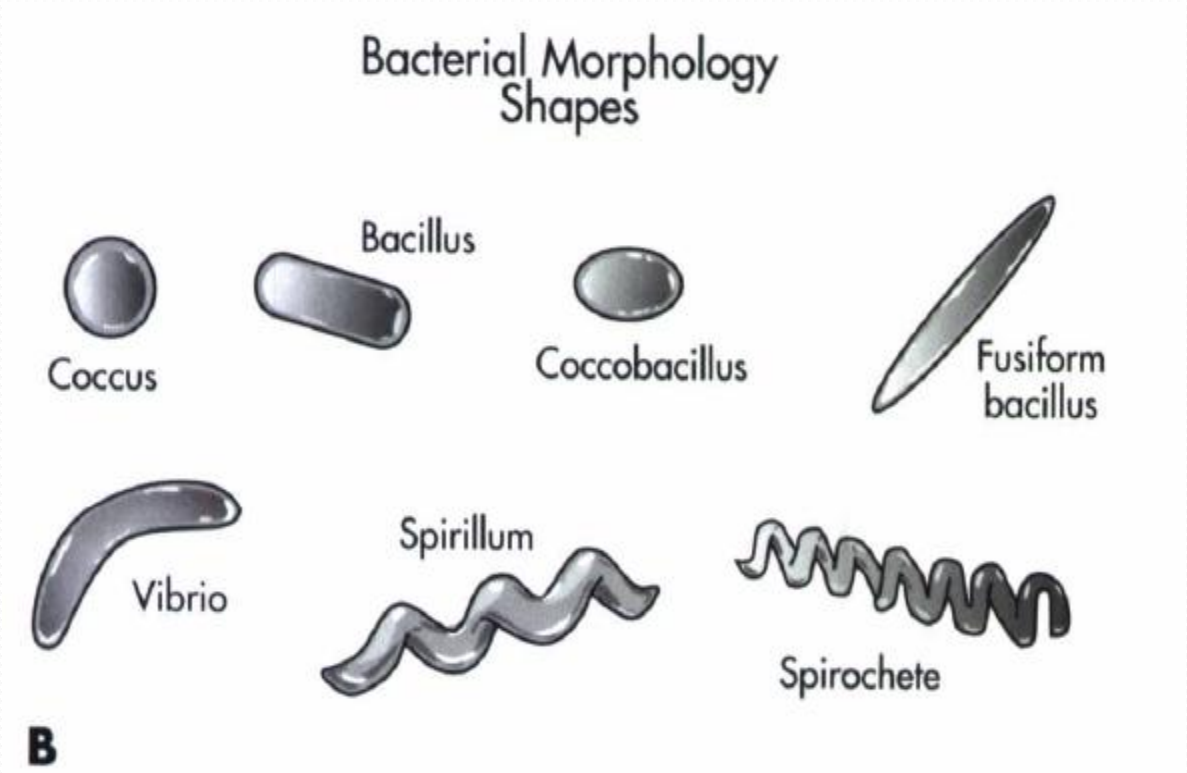
در هر گرم مدفوع 10^{11} ارگانیسم وجود دارد.

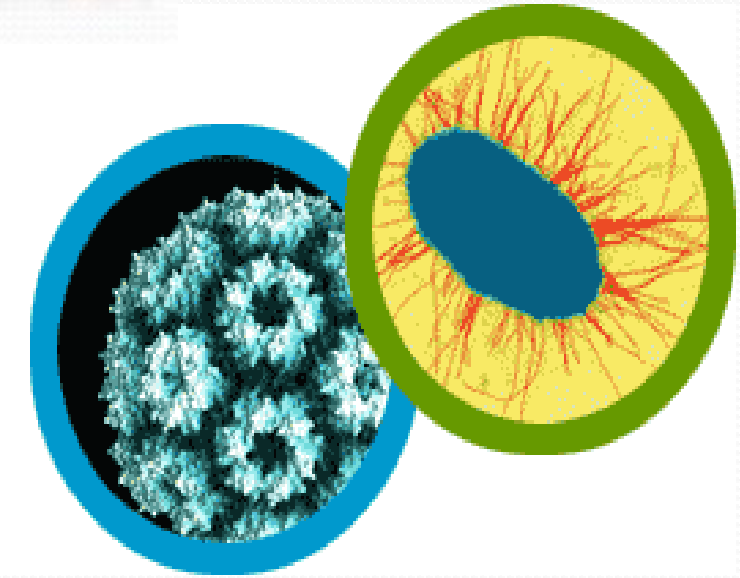
Microbes make up a considerable part of the **biosphere**

Microbiology is a multifaceted discipline:

- ✓ **Infectious disease**
- ✓ **Agricultural practice**
- ✓ **Sanitation**
- ✓ **Industrial production of food, beverages, and chemicals**
- ✓ **Important model for studies in nutrition, metabolism, genetics, and biochemistry**

Length & shape





میکروبها موجودات زنده تک سلولی بسیار ریزی هستند که میلیونها بر نوک سوزنی جای می گیرند.

10^{-3}

10^{-6}

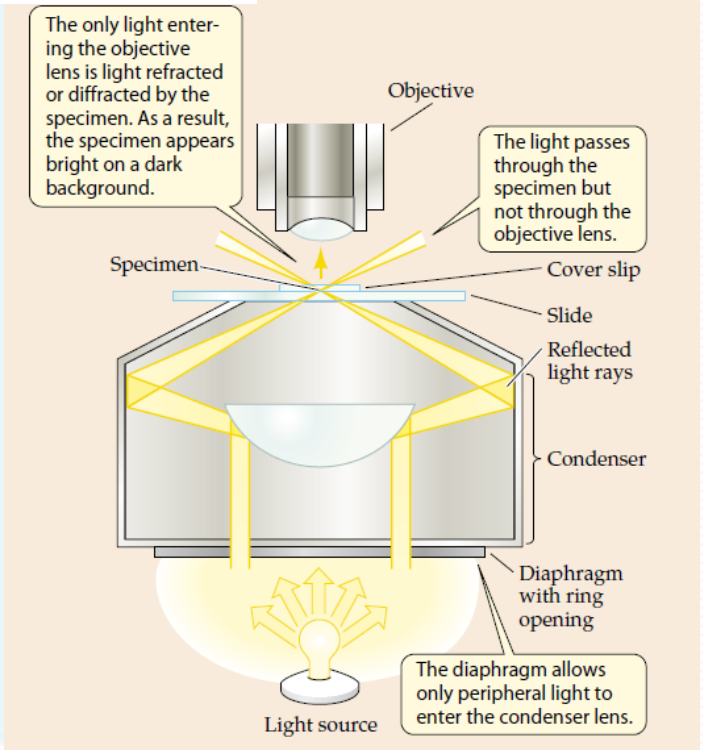
10^{-8}

Length

- Light Microscope
- Dark field Microscope
- Fluorescence Microscope
- Electron microscope
  - TEM
  - SCM

Darkfield Microscope

- Wet-mount preparations
- Live cells appear bright against a dark background

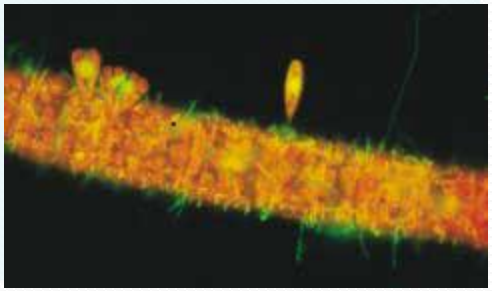


Phase Contrast Microscope

- Most microbial cells appear to be colorless & transparent objects when observed by ordinary brightfield microscopy
- For amplification of slight difference in refractive index & converts it to a difference in contrast.
- As a result, cells appear very dark against a bright background

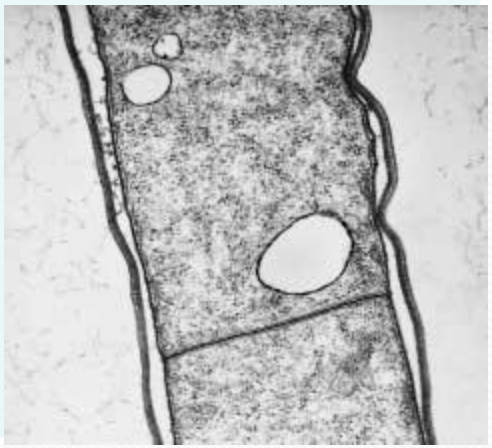
Fluorescence Microscope

- Fluorescent dyes: for staining microorganisms by short-wavelength light
- Acridine orange for staining of nucleic acid components of cells
- Special advantage : allows the observation of cells located on an opaque surface



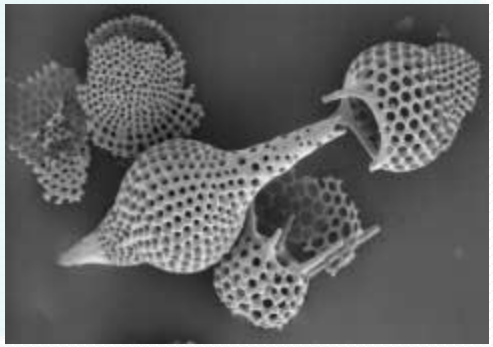
Transmission Electron Microscope (TEM)

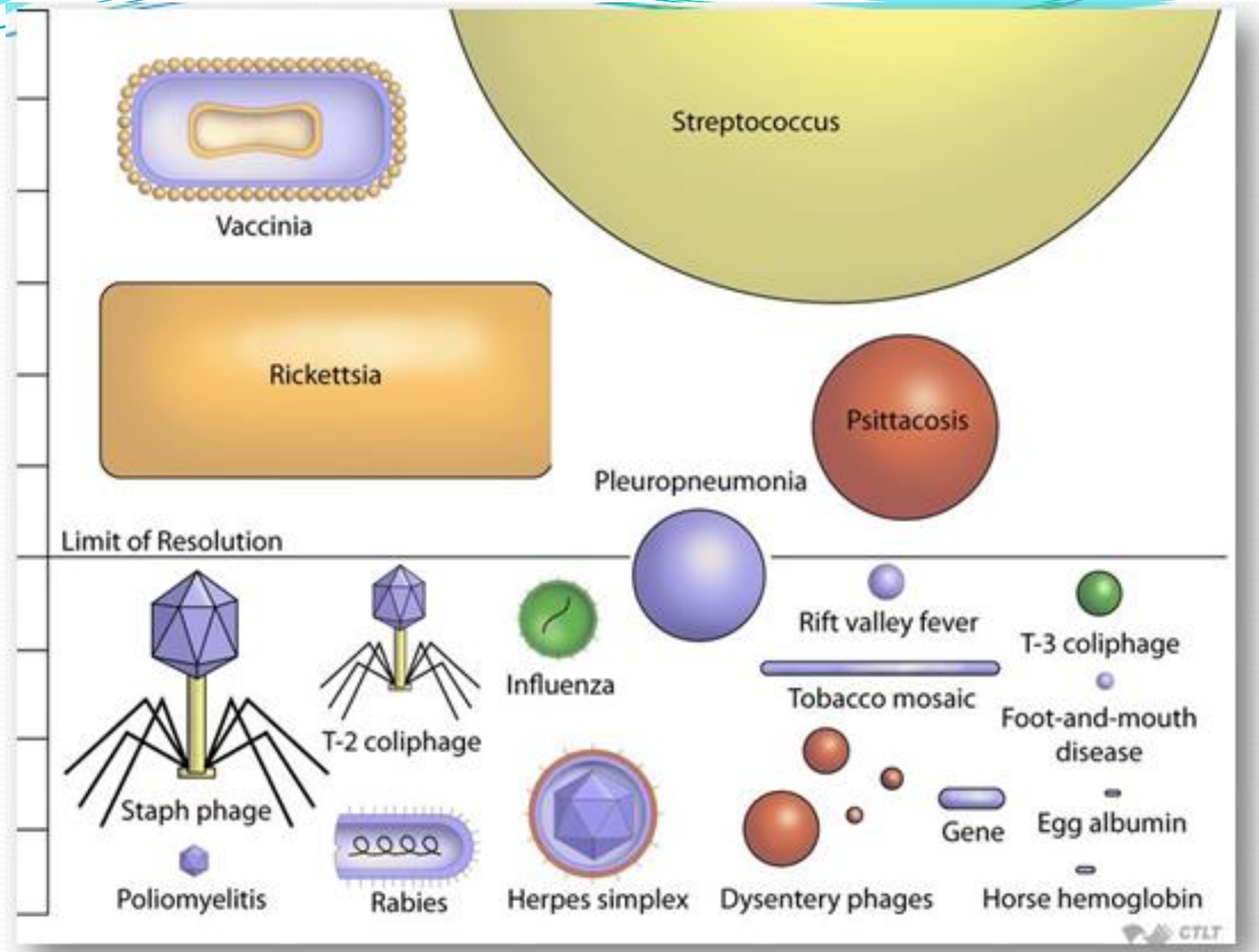
- The light microscope has a useful magnification of about 1,000X to 2,000X
- Produce very short wavelengths by using a beam of electrons
- Theoretical resolution: 2 Å (Å is an angstrom; 1 Å = 10^{-10} m)
- Is use to observe internal cell structures

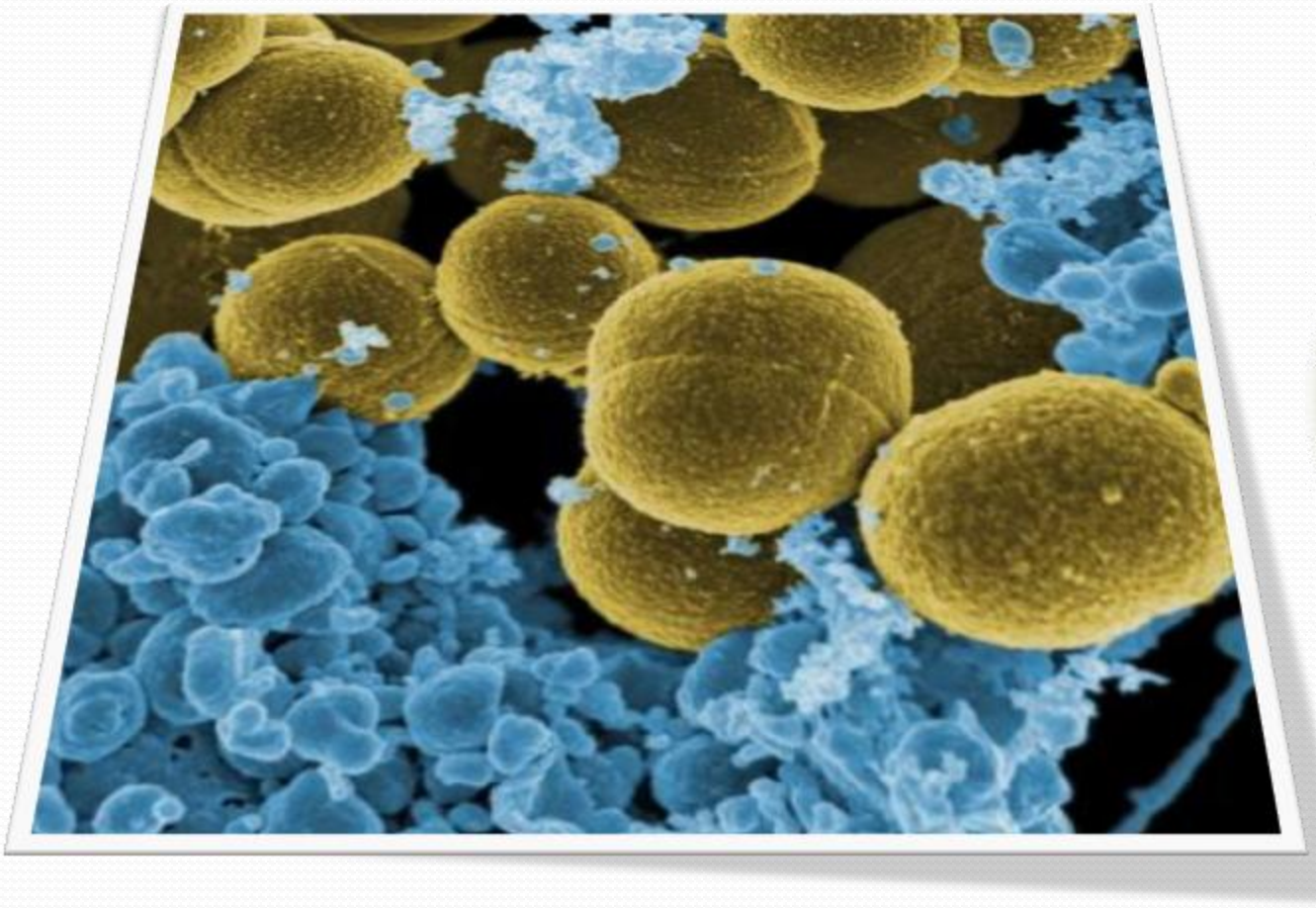


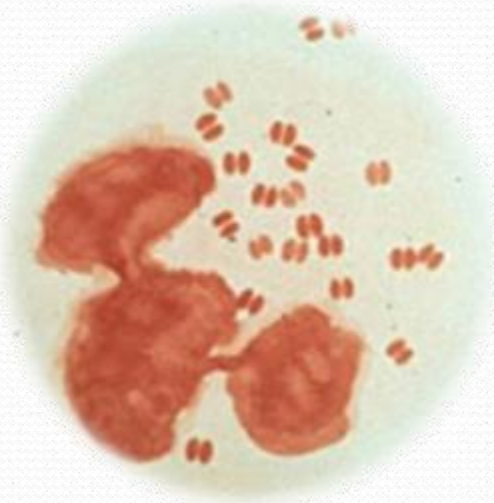
Scanning Electron Microscope (SEM)

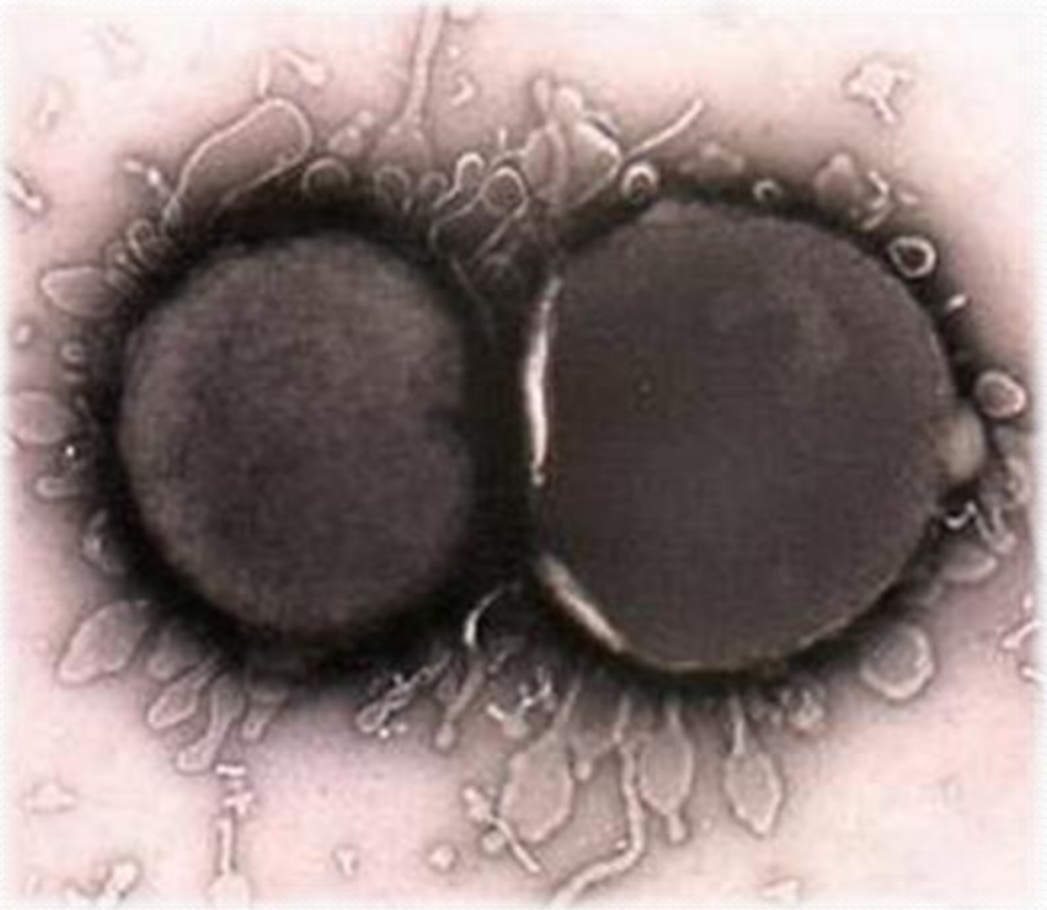
- Electrons are not transmitted through the specimen
- Electrons scanned across the specimen and back-scattered (reflected) from the specimen
- Critical point drying approach

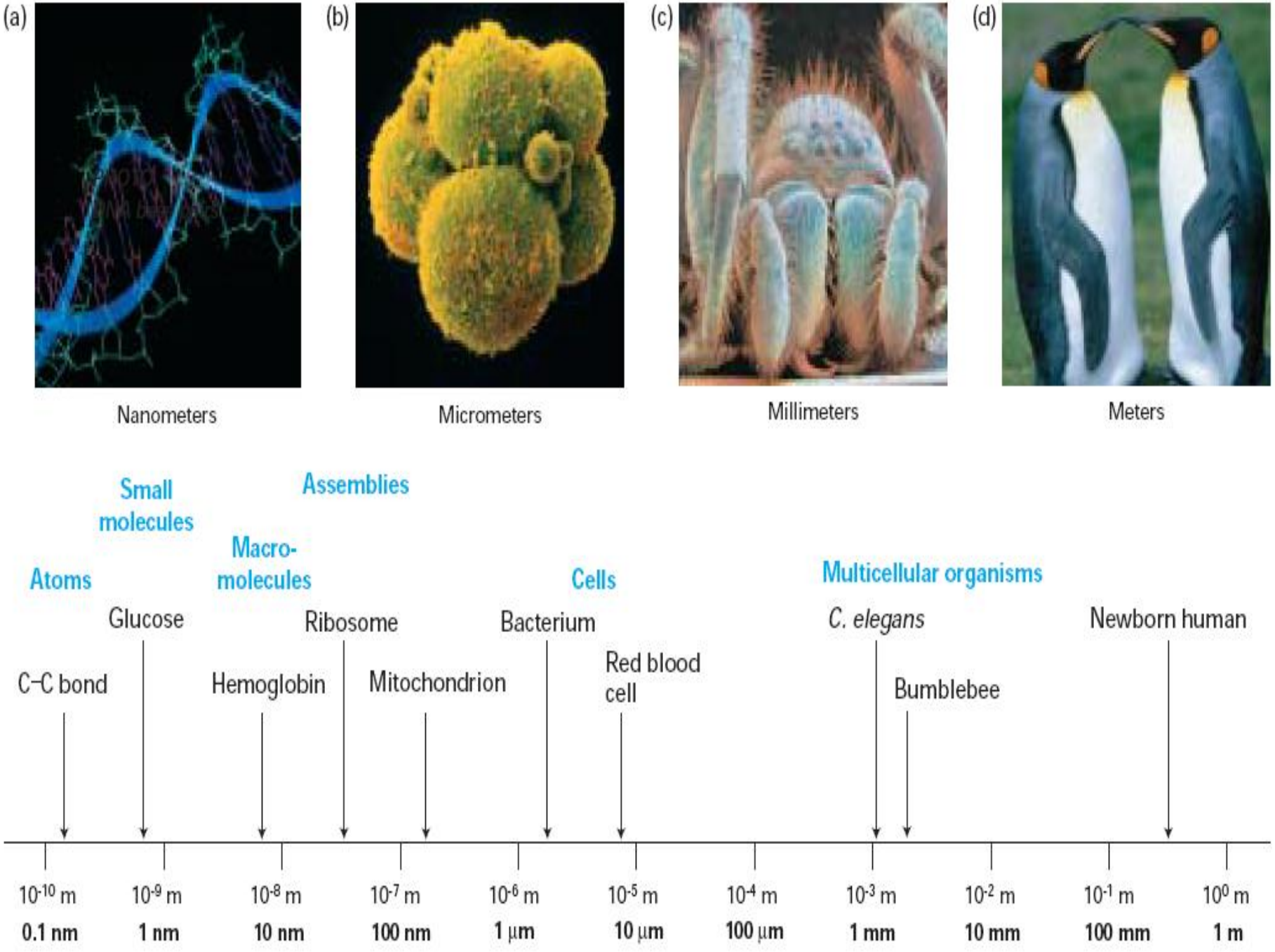



Streptococcus
Vaccinia
Rickettsia
Psittacosis
Pleuropneumonia
Limit of Resolution
Rift valley fever
T-3 coliphage
Influenza
Tobacco mosaic
Foot-and-mouth disease
T-2 coliphage
Staph phage
Gene
Egg albumin
Poliomyelitis
Rabies
Herpes simplex
Dysentery phages
Horse hemoglobin
CTLT

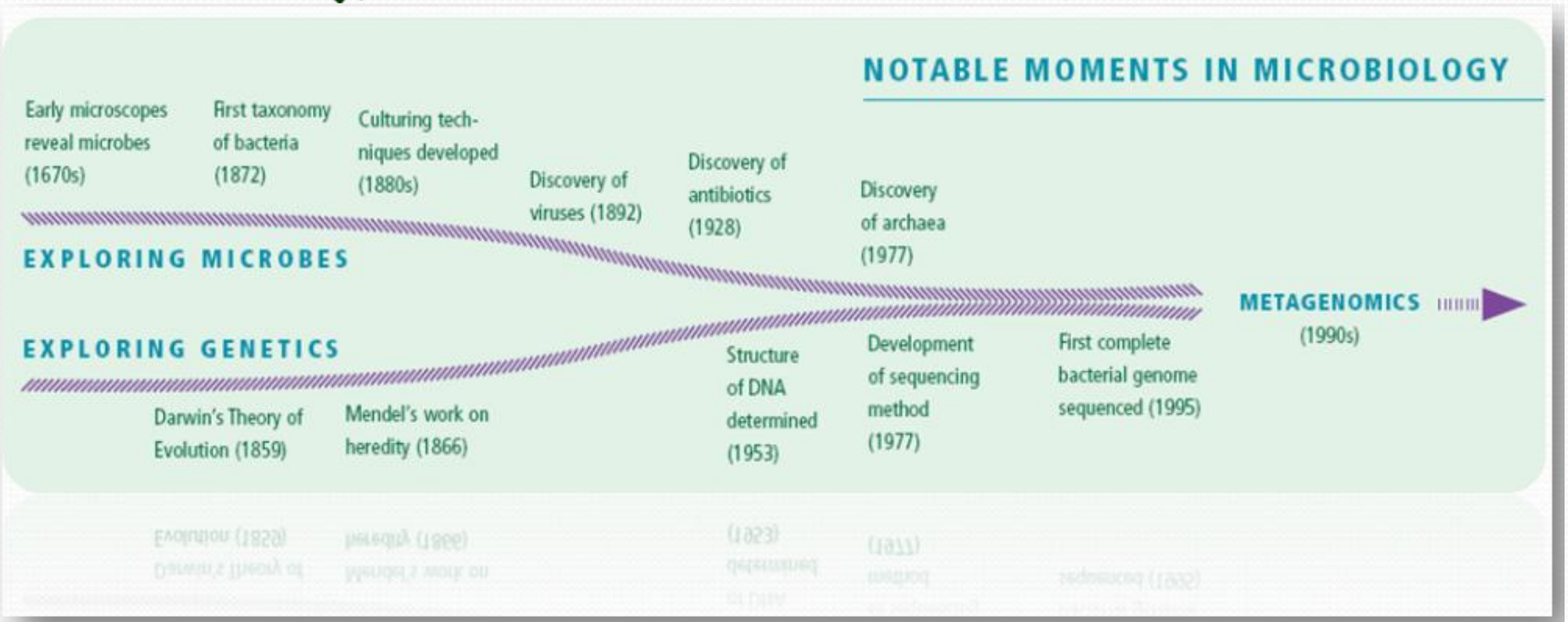







(a)
(b)
(c)
(d)
Nanometers
Micrometers
Millimeters
Meters
Small molecules
Assemblies
Atoms
Macro-molecules
Cells
Multicellular organisms
Glucose
Ribosome
Bacterium
C. elegans
Newborn human
C–C bond
Hemoglobin
Mitochondrion
Red blood cell
Bumblebee
10-10 m
10-9 m
10-8 m
10-7 m
10-6 m
10-5 m
10-4 m
10-3 m
10-2 m
10-1 m
100 m
0.1 nm
1 nm
10 nm
100 nm
1 μm
10 μm
100 μm
1 mm
10 mm
100 mm
1 m

لحظات حیاتی در تاریخ میکروبیولوژی



THE METAGENOMICS PROCESS

Extract all DNA from microbial community in sampled environment

DETERMINE WHAT THE GENES ARE

(Sequence-based metagenomics)

- Identify genes and metabolic pathways
- Compare to other communities
- and more…

DETERMINE WHAT THE GENES DO

(Function-based metagenomics)

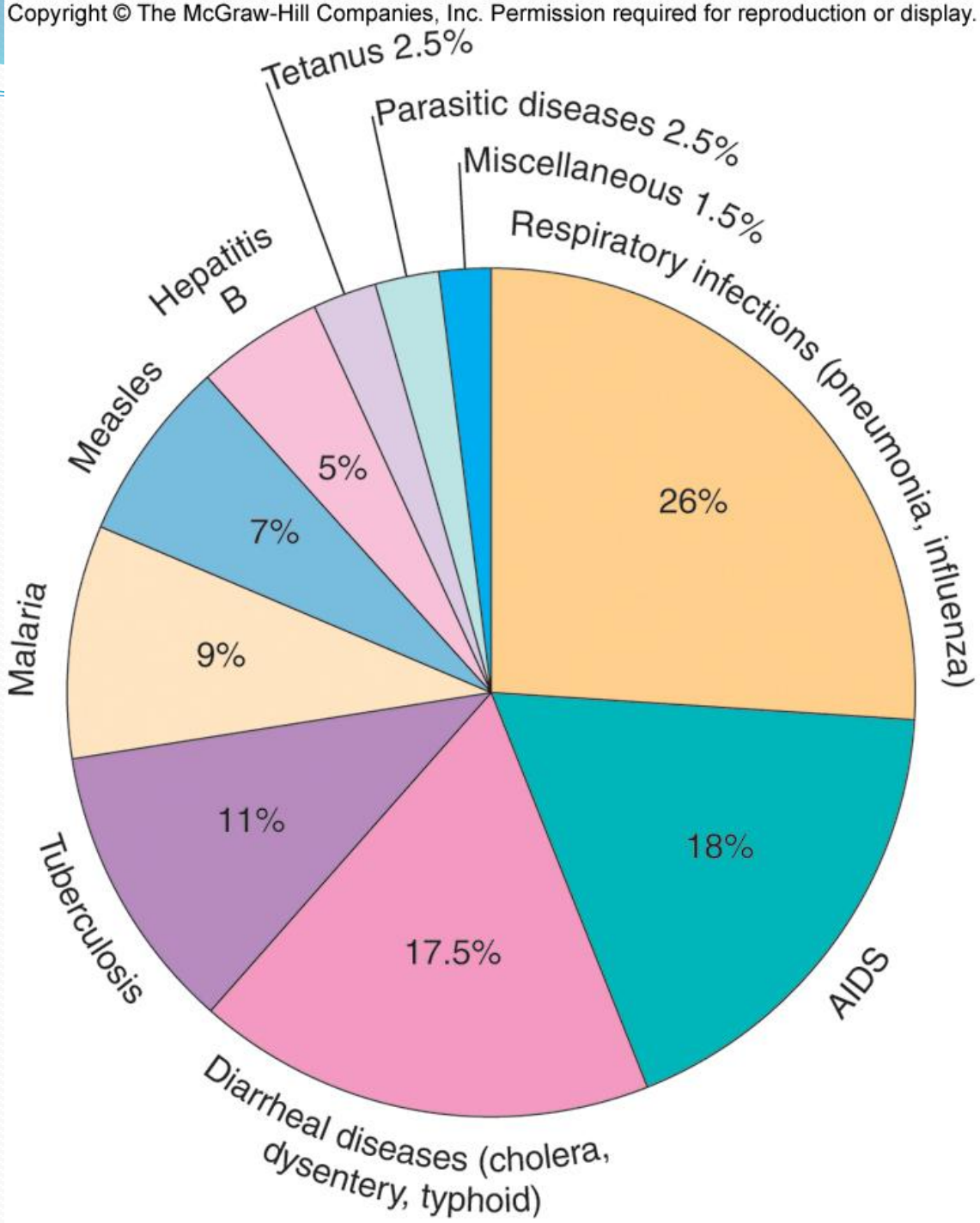
- Screen to identify functions of interest, such as vitamin or antibiotic production
- Find the genes that code for functions of interest
- and more…

Metagenomics transcends individual genes and genomes, enabling scientists to study the entire genetic makeup of a community as a whole. It is the science of microbial communities.

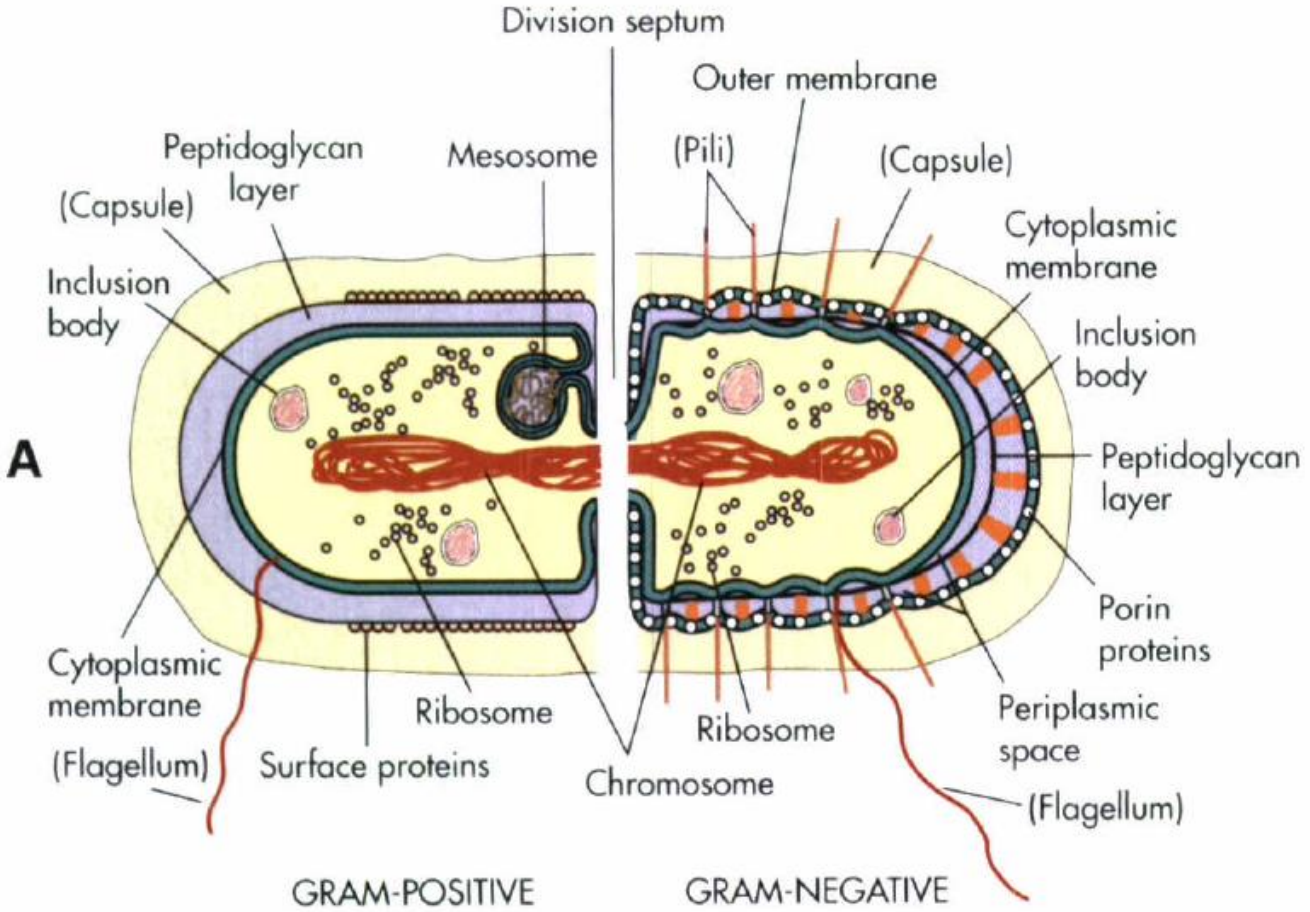
Top Causes of Death

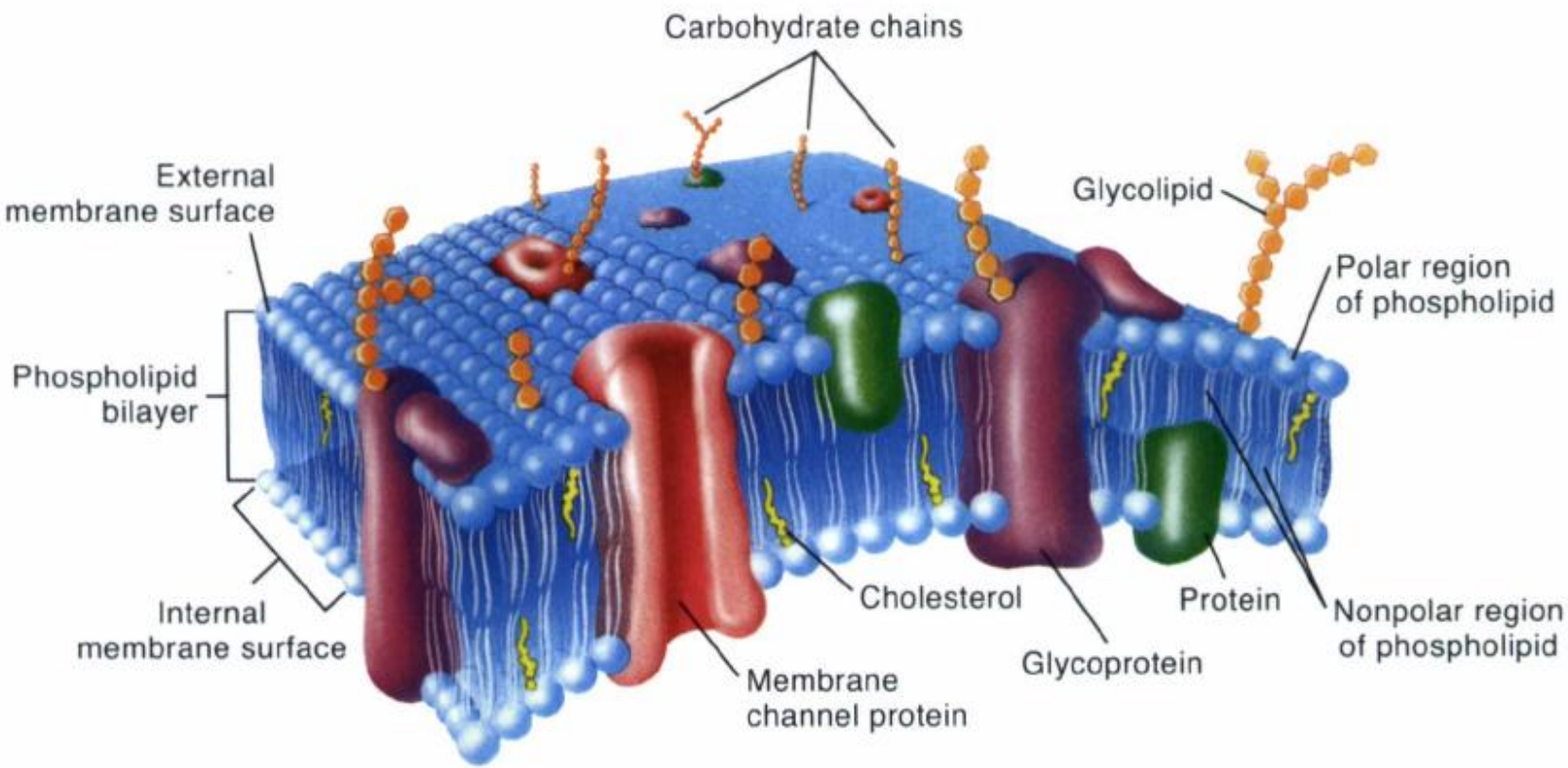
United States	Deaths	Worldwide	Deaths
1. Heart Disease	696,950	1. Heart Disease	8.12×10^6
2. Cancer	557,270	2. Stroke	5.51×10^6
3. Stroke	162,670	3. Respiratory infection	3.88×10^6
4. Chronic LRD*	124,800	4. Cancer	3.33×10^6
5. Accidents	106,740	5. HIV/AIDS	2.78×10^6
6. Diabetes	73,250	6. Chronic LRD*	2.75×10^6
7. Flu & Pneumonia	65,680	7. Diarrheal disease	1.80×10^6
8. Alzheimer disease	58,870	8. Tuberculosis	1.57×10^6
9. Kidney problems	40,970	9. Malaria	1.27×10^6
10.Septicemia	33,865	10. Accidents	1.19×10^6

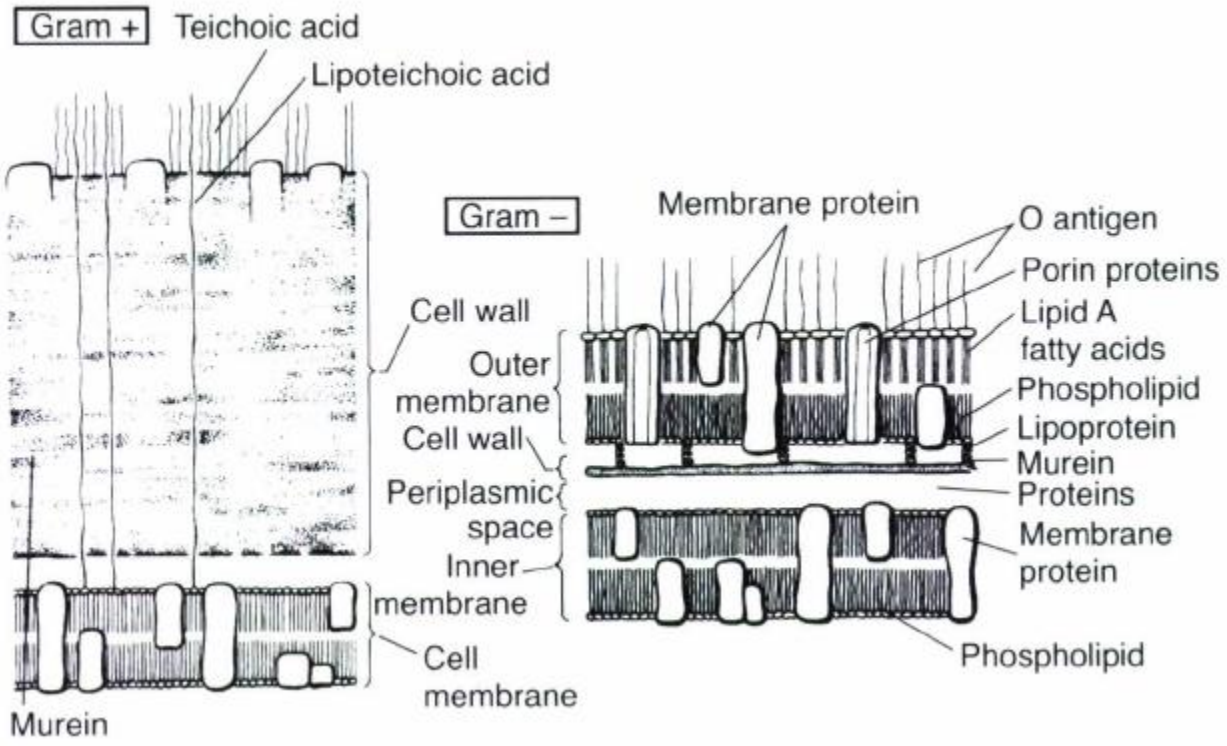
Infectious Disease Statistics

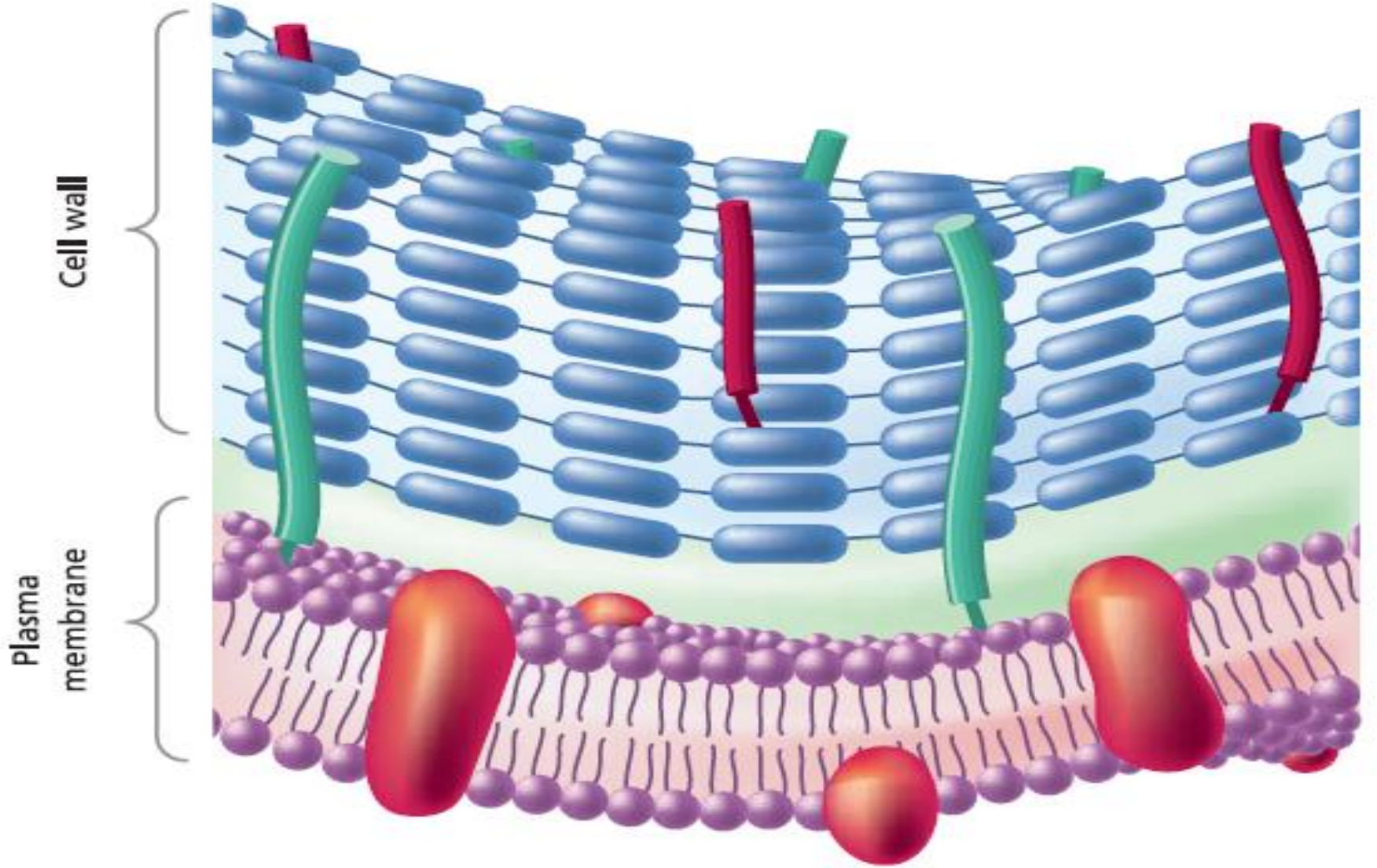


Microbiology

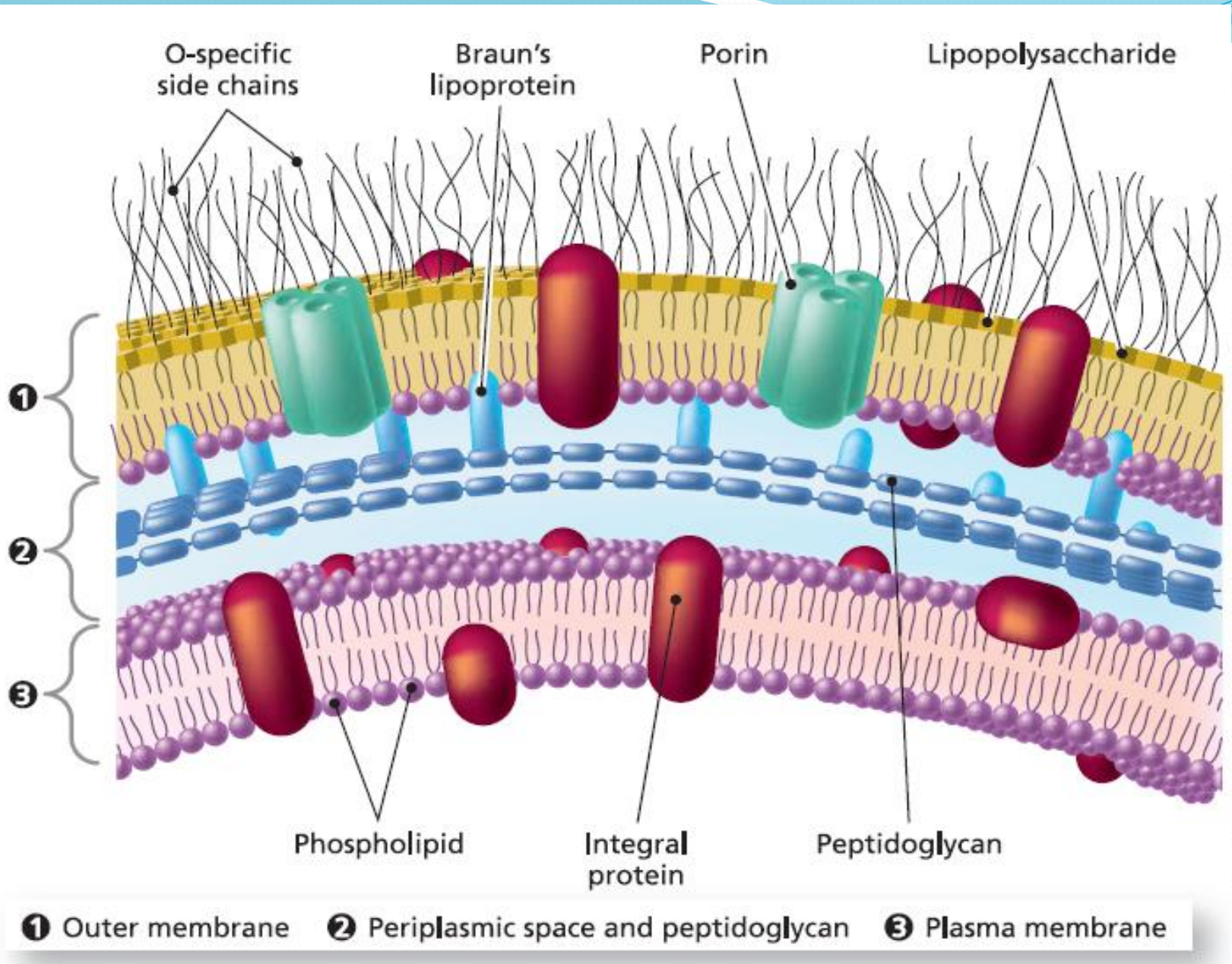



Carbohydrate chains
External membrane surface
Glycolipid
Polar region of phospholipid
Phospholipid bilayer
Internal membrane surface
Cholesterol
Protein
Nonpolar region of phospholipid
Glycoprotein
Membrane channel protein


Gram +
Teichoic acid
Lipoteichoic acid
Cell wall
Murein
Gram –
Membrane protein
O antigen
Porin proteins
Lipid A
fatty acids
Phospholipid
Lipoprotein
Murein
Proteins
Membrane
protein
Phospholipid
Outer
membrane
Cell wall
Periplasmic
space
Inner
membrane
Cell
membrane

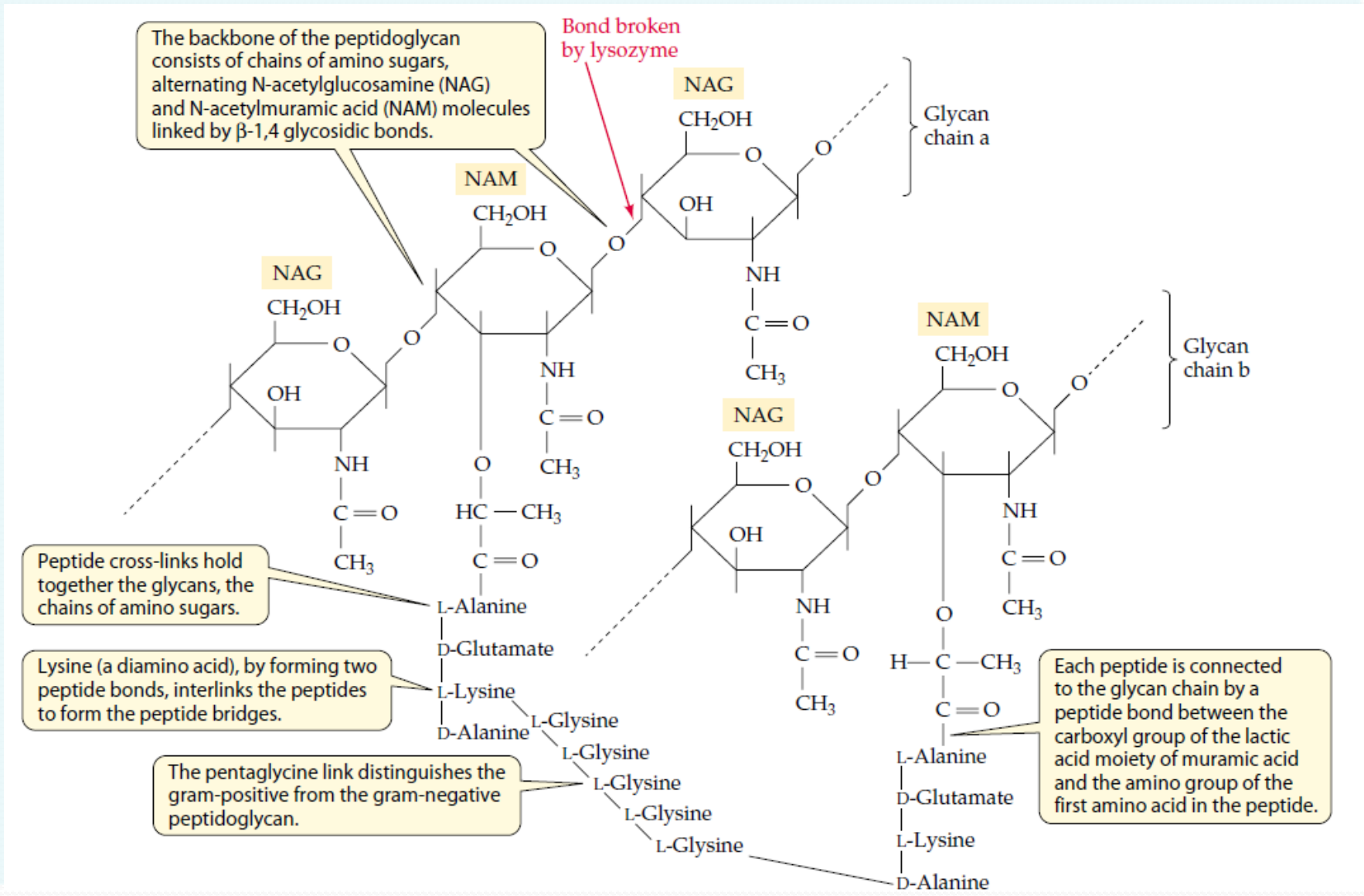


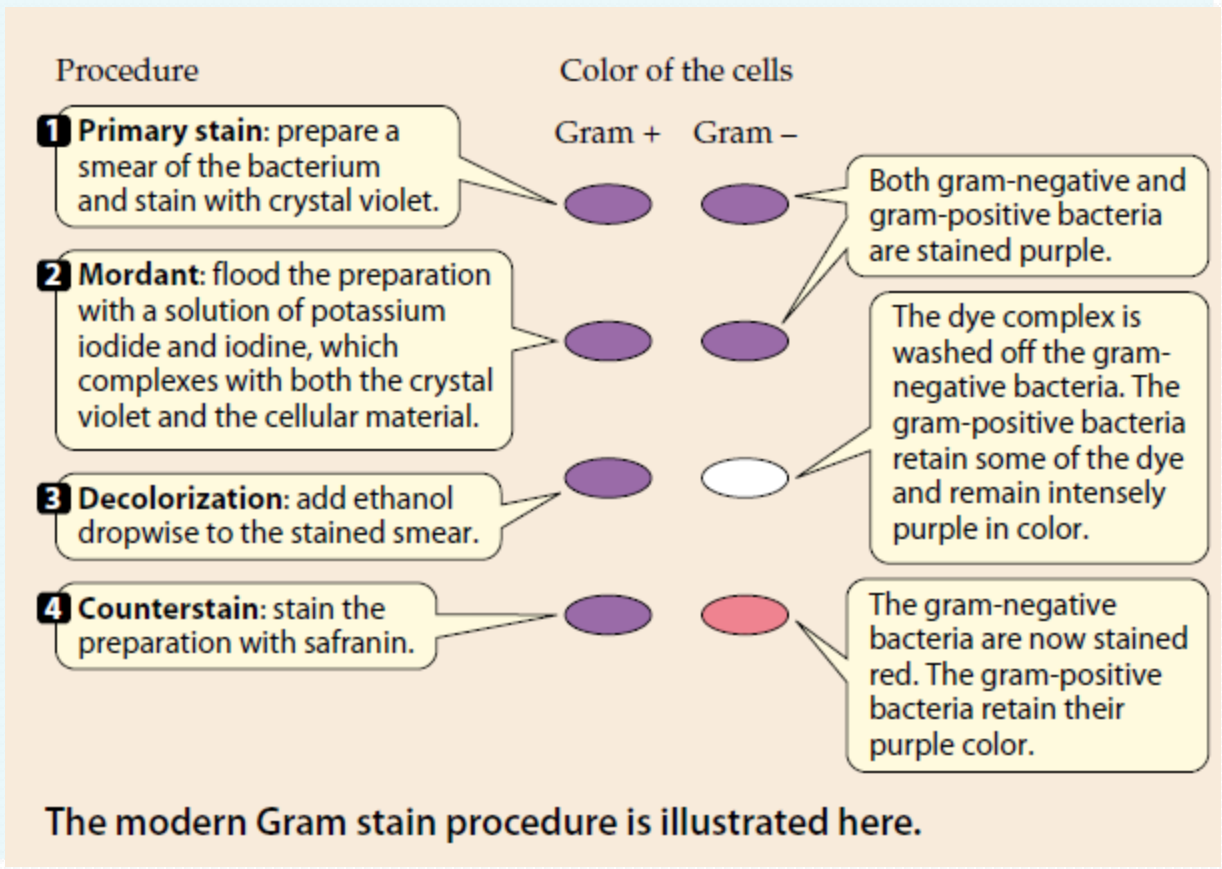
Source: Prescott, Harley, Klein. *Microbiology,* 5th ed. New York: McGraw-Hill, 1996.


O-specific side chains
Braun's lipoprotein
Porin
Lipopolysaccharide
1
2
3
Phospholipid
Integral protein
Peptidoglycan
1 Outer membrane
2 Periplasmic space and peptidoglycan
3 Plasma membrane

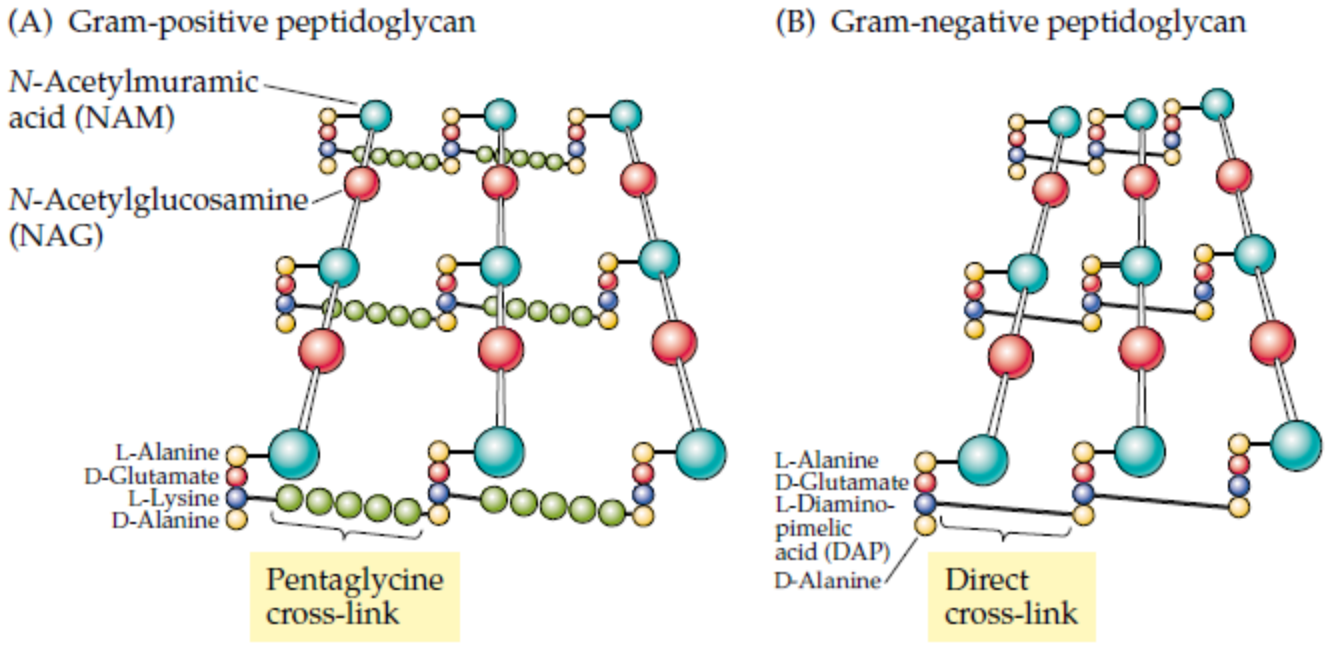
Cell Walls

- **Essential** to the microorganisms
- Bacteria cell walls called **peptidoglycan**, or murein
- **Varies** from one bacterial species to another
- Two amino sugars, **N-acetylglucosamine** and **N-acetylmuramic**, are joined together by beta-1,4 linkages to form a chain, or linear polymer
- The chains of amino sugars are cross-linked by **peptides**


The backbone of the peptidoglycan consists of chains of amino sugars, alternating N-acetylglucosamine (NAG) and N-acetylmuramic acid (NAM) molecules linked by β-1,4 glycosidic bonds.
Bond broken by lysozyme
NAG
NAM
NAG
NAG
NAM
Glycan chain a
Glycan chain b
Peptide cross-links hold together the glycans, the chains of amino sugars.
Lysine (a diamino acid), by forming two peptide bonds, interlinks the peptides to form the peptide bridges.
The pentaglycine link distinguishes the gram-positive from the gram-negative peptidoglycan.
Each peptide is connected to the glycan chain by a peptide bond between the carboxyl group of the lactic acid moiety of muramic acid and the amino group of the first amino acid in the peptide.
L-Alanine
D-Glutamate
L-Lysine
D-Alanine
L-Glysine
L-Glysine
L-Glysine
L-Glysine
L-Glysine
L-Alanine
D-Glutamate
L-Lysine
D-Alanine



The modern Gram stain procedure is illustrated here.

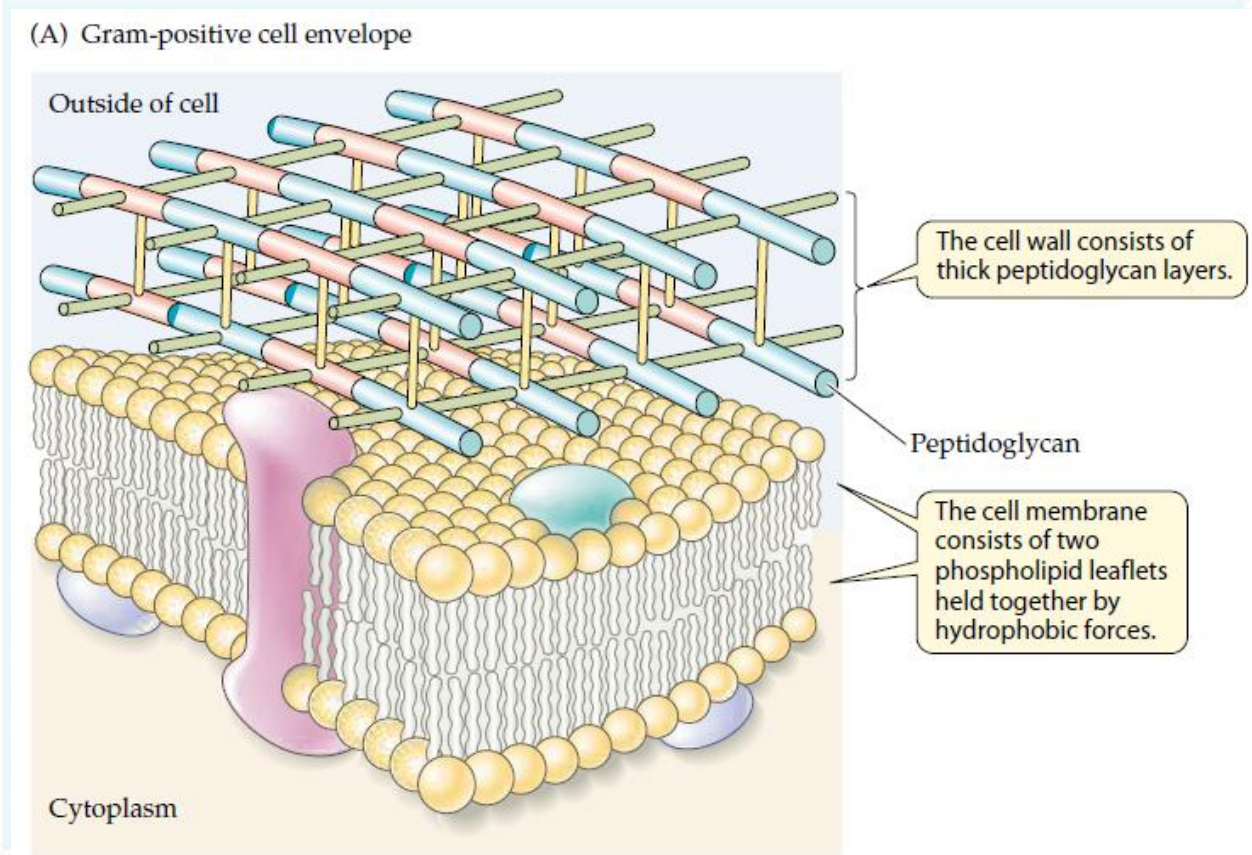


Cell walls of gram-positive and gram-negative bacteria

The diagrams show the two-dimensional network of the peptidoglycan sac surrounding (A) a gram-positive and (B) a gram-negative cell. This layer is the major structural component of bacterial cell walls. The *N*-acetylglucosamine (NAG) and *N*-acetylmuramic acid (NAM) are linked to form the amino sugar backbone (glycan). The glycan chains are held together by peptide bridges.

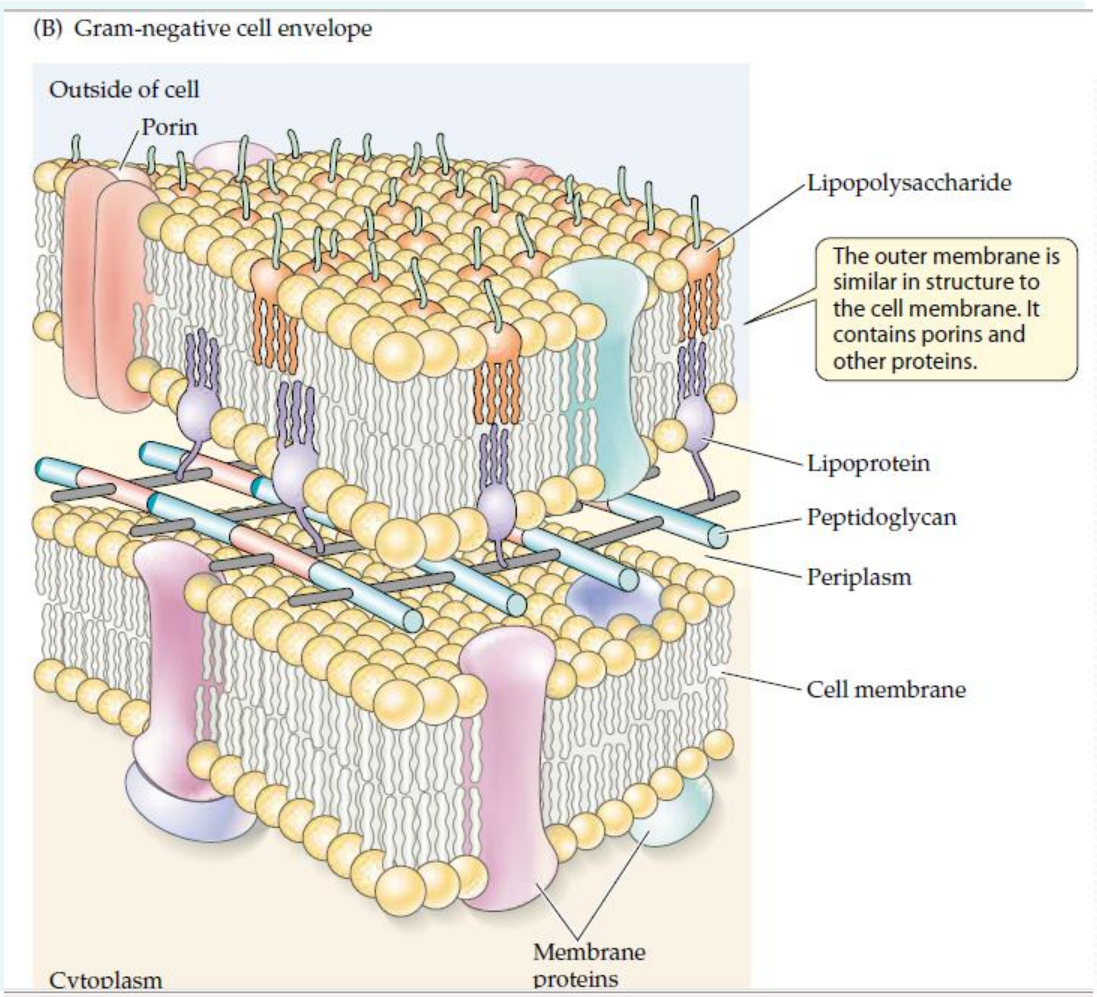
Gram-Positive Bacterial Cell Walls

- **thick, nearly uniformly dense layers**
  - **peptidoglycan (to 80%), teichoic acids and teichuronic acids, polyol phosphate polymers (polyglycerol phosphate and polyribitol phosphate)**



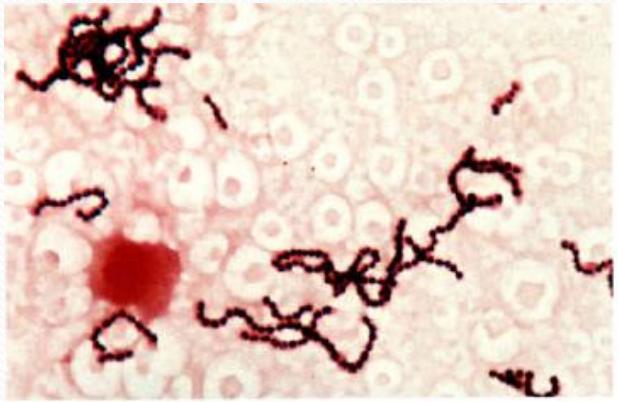
Gram-Negative Bacterial Cell Walls

- **more complex , outer membrane**
  - **peptidoglycan (smaller proportion in single or a few macromolecular sheets, 5%,), lipids, proteins, polysaccharides**

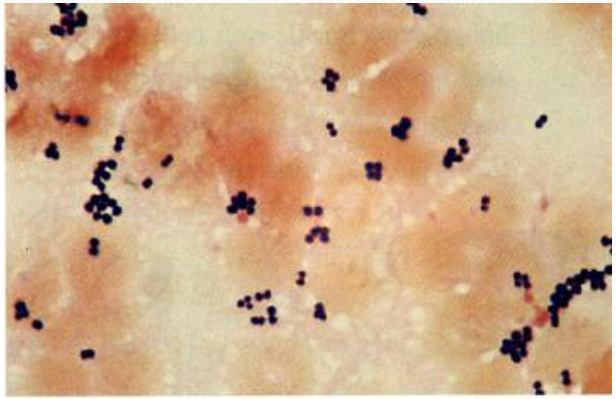


Gram staining

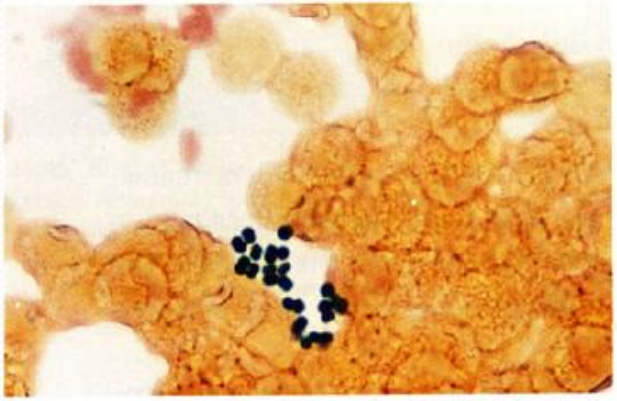
- Crystal violet 1min
  - wash
- KI 1% 30 sec
  - Wash
- Alcohol – acetone 15-30 sec
  - Wash
- Safranin
  - Wash
- check

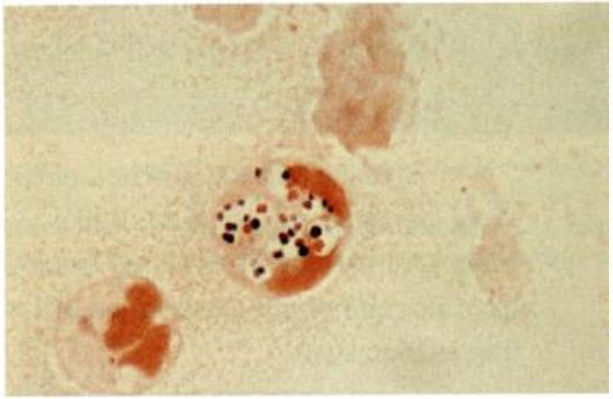


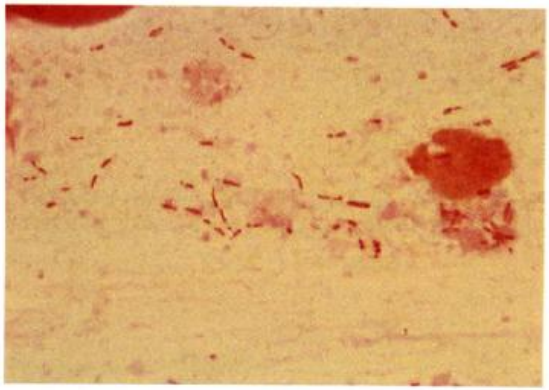
4-3 Gram-positive cocci in chains resembling streptococci (×1250).



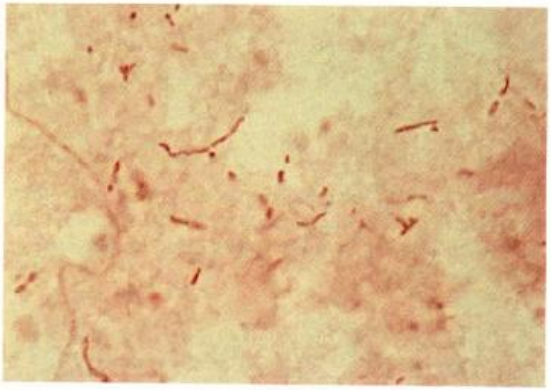
4-4 Gram-positive cocci in pairs, tetrads, and clusters resembling staphylococci (×1250)



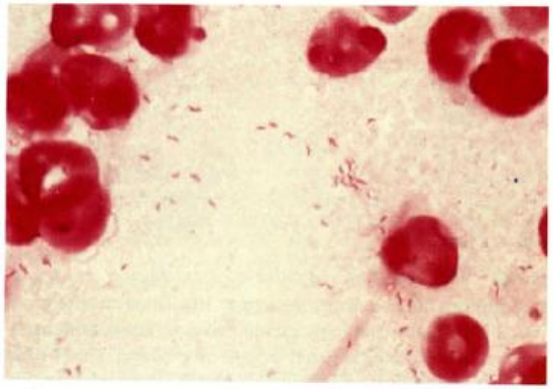


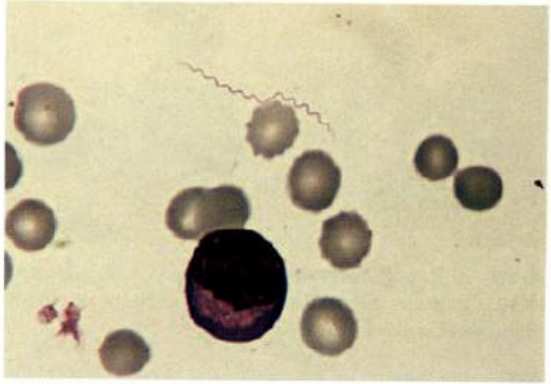


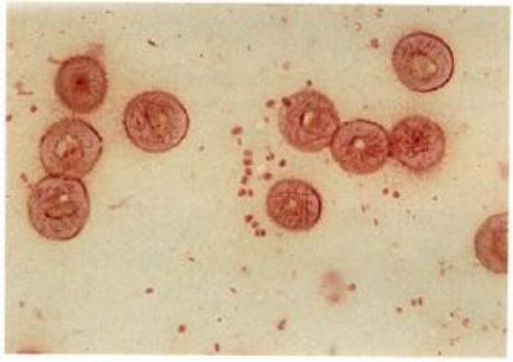
4-22 Poorly differentiated PMN and slender pleomorphic gram-negative bacilli suggestive of *Haemophilus* spp. or anaerobes (×1250).



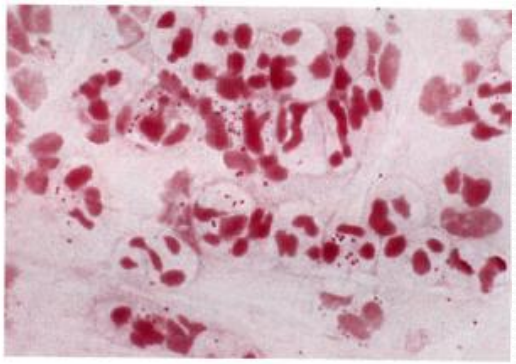
4-23 Extremely pleomorphic, variably staining gram-negative bacilli with pointed ends suggestive of *Fusobacterium* spp. (×1250).



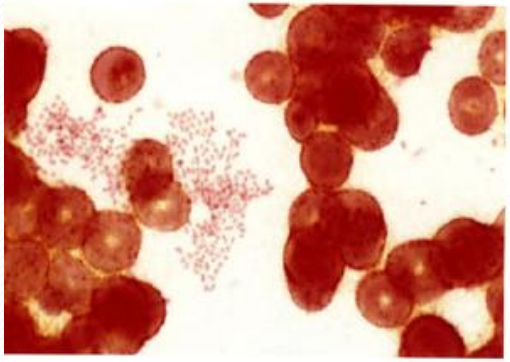


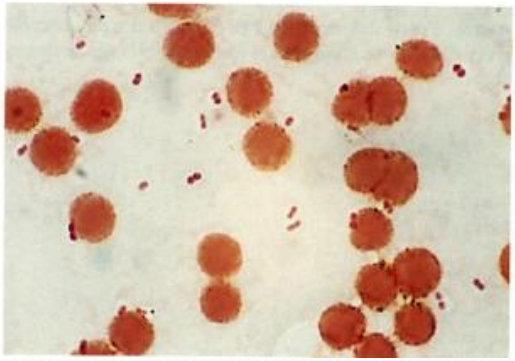


4-16 RBC and gram-negative cocci in singles and pairs. The adjacent sides of the diplococci appear flattened (×1250). This microorganism is *Neisseria meningitidis* stained from a blood culture broth.



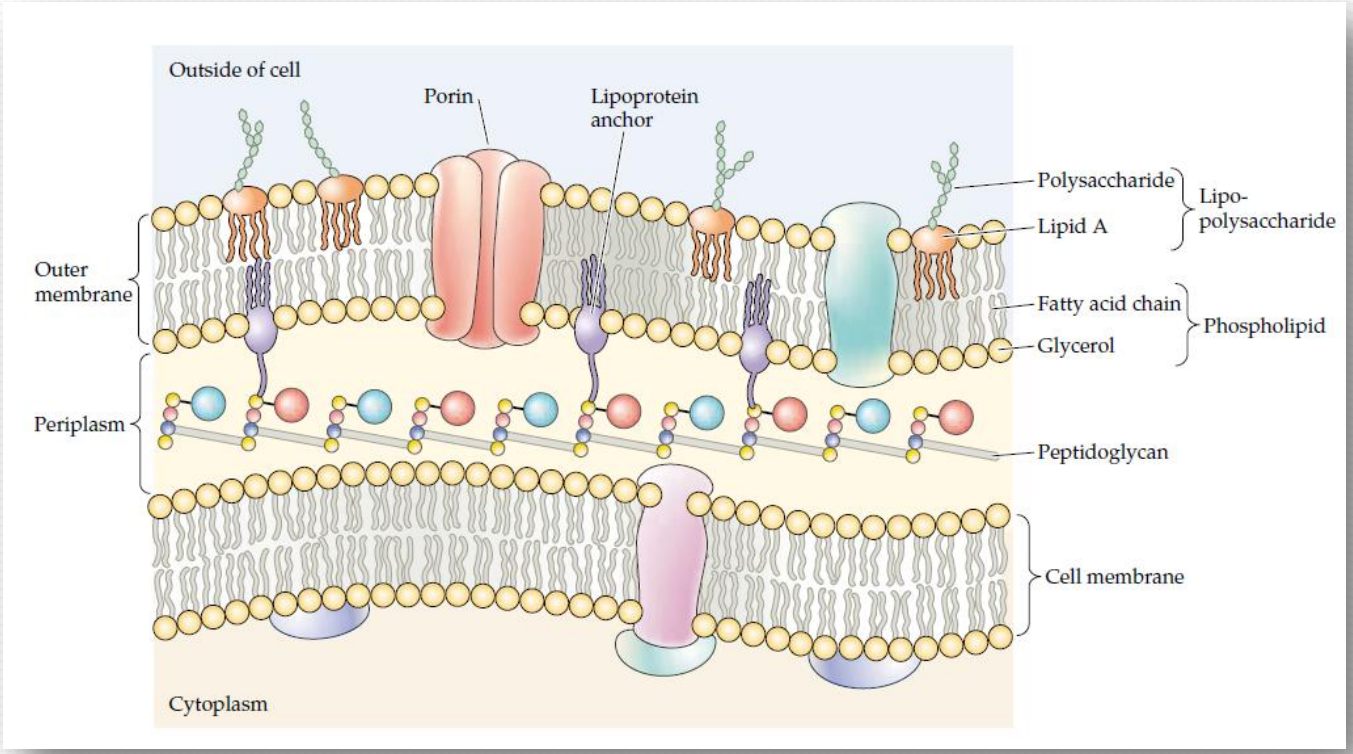
4-17 Urethral discharge with PMN and intracellular gram-negative diplococci suggestive of *Neisseria gonorrhoeae* (×1250).

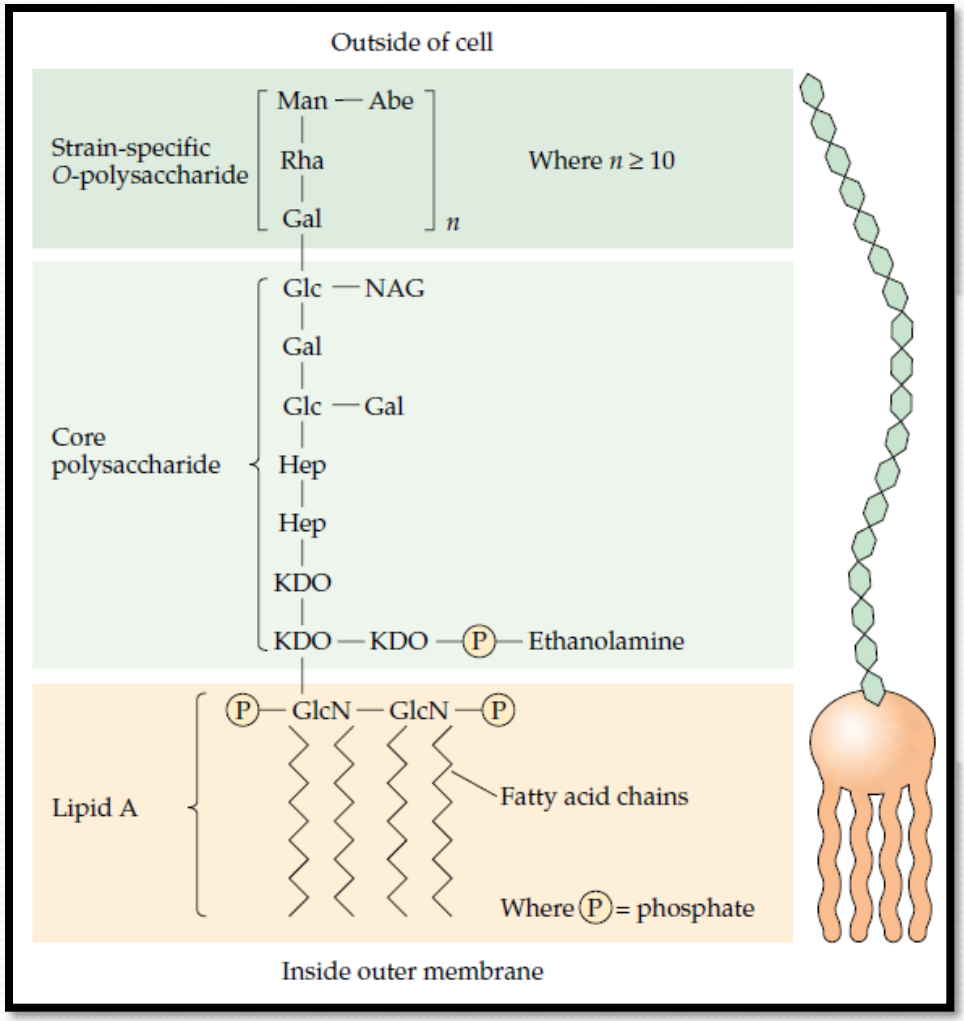




LPS

- Have specific side-chain polysaccharides (O-polysaccharides) that vary from one species to another.
- The LPS that contains lipid A is called endotoxin (fever, hemorrhage, shock, miscarriage, and a variety of other symptoms depending upon the dose and source

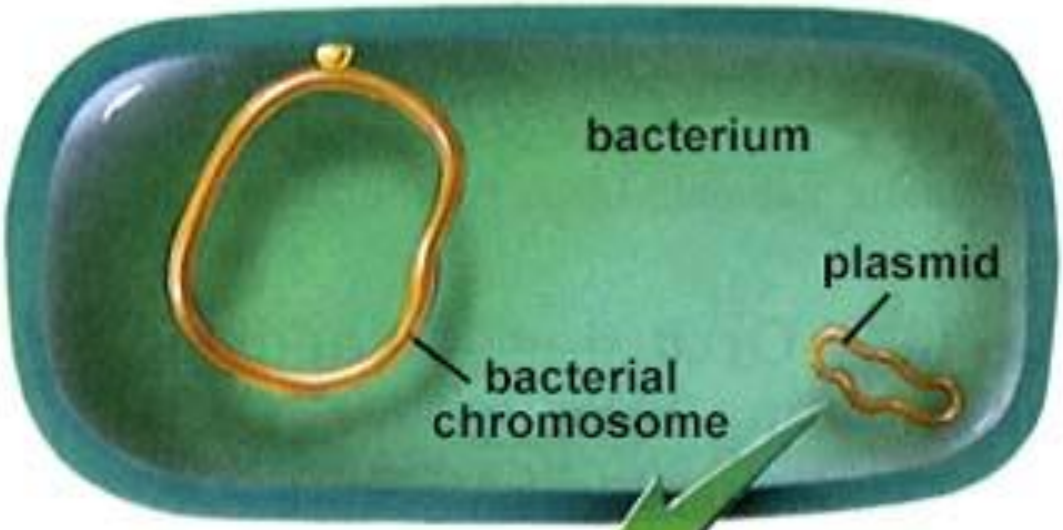




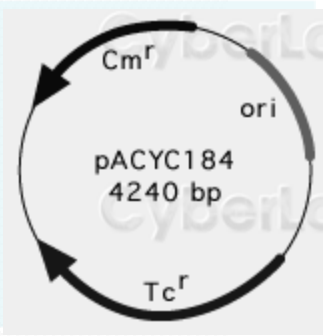
Polysaccharide of LPS

Chemical composition of the polysaccharide portion of LPS in a *Salmonella* strain. The polysaccharide portion extends outside the cell, where it acts as a strain-specific antigen, and may serve to help attach the cell in its environment. Abe, abequose; Gal, galactose; Glc, glucose; GlcN, glucosamine; Hep, heptose; KDO, ketodeoxyoctanoate; Man, mannose; NAG, *N*-acetylglucosamine; Rha, rhamnose.

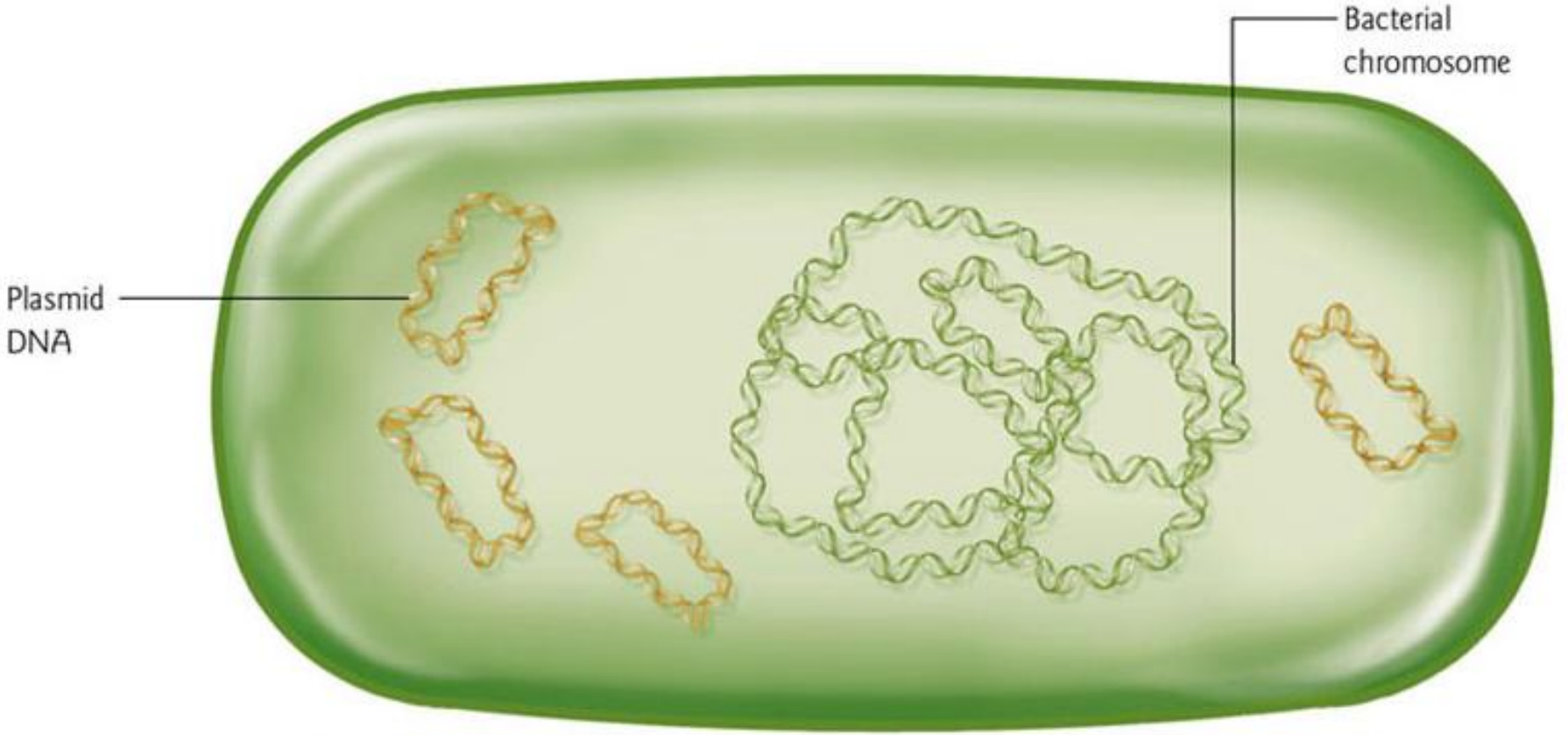
پلاسمید


bacterium
plasmid
bacterial
chromosome

1 um


Cm^r
ori
pACYC184
4240 bp
Tc^r

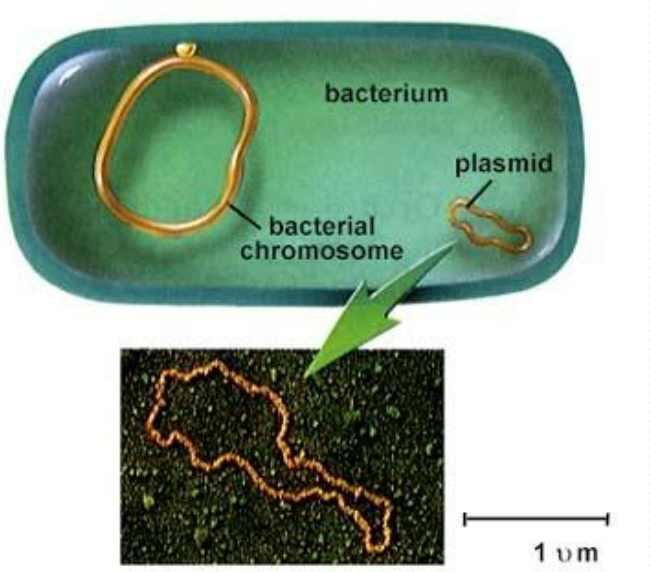
پلاسمید



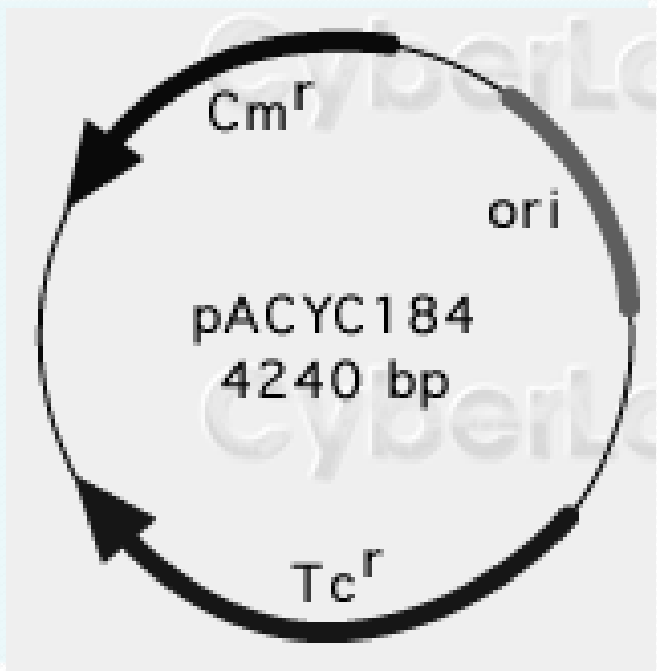
Plasmid = small, circular extrachromosomal DNA molecule capable of autonomous replication within a bacterial cell; a commonly used cloning vector.

What are Plasmids?

Small, circular, extrachromosomal DNA molecules. They can replicate independently of the genome, and are found in numbers ranging from one per cell to hundreds per cell (this is called "copy number"). Plasmids frequently carry genes for antibiotic resistance. While antibiotic resistance is becoming an increasingly important problem medically, it is a useful marker in Recombinant DNA technology. Such markers, along with the small size and potentially high copy number, make plasmids indispensible tools in Molecular Biology.



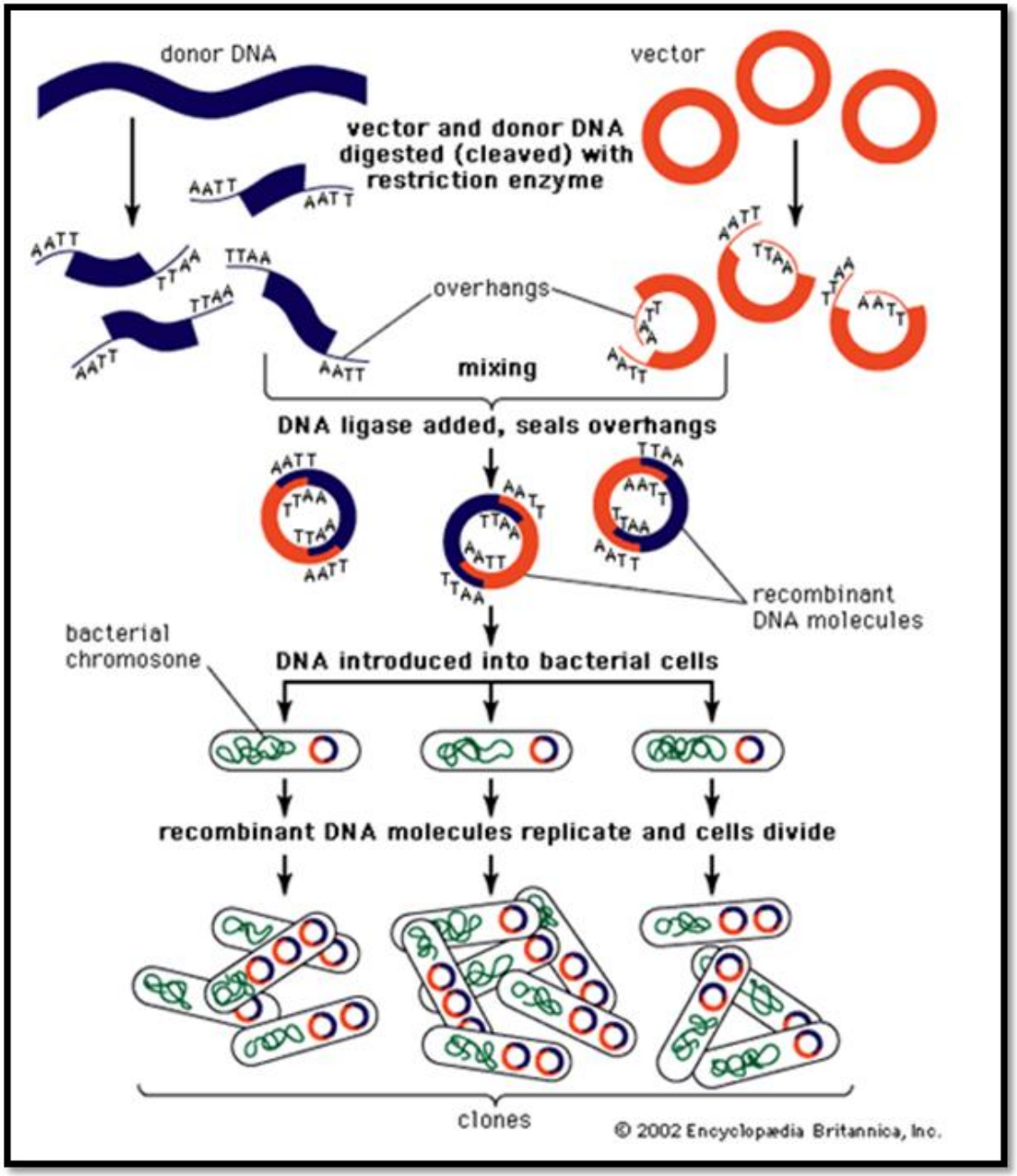
ساختار پلاسمید



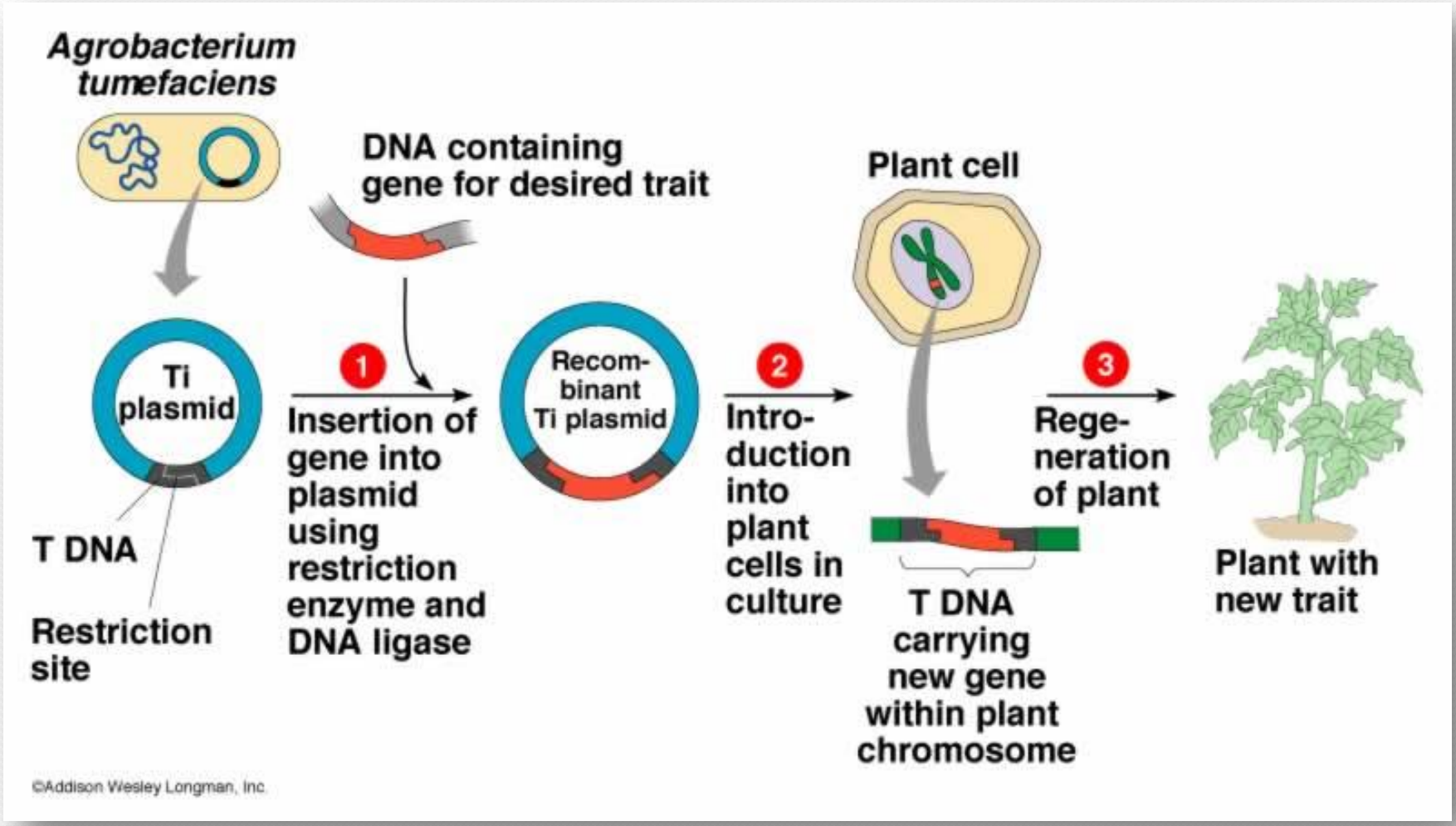
This plasmid map has 3 marked regions on it. Two of them are antibiotic resistance genes, one for Tetracycline resistance (Tc) and the other for Chloramphenicol resistance (Cm).

The other marked region (ori) is the origin of replication, the region where the DNA replication machinery assembles.

دی ان ای نوترکیبی

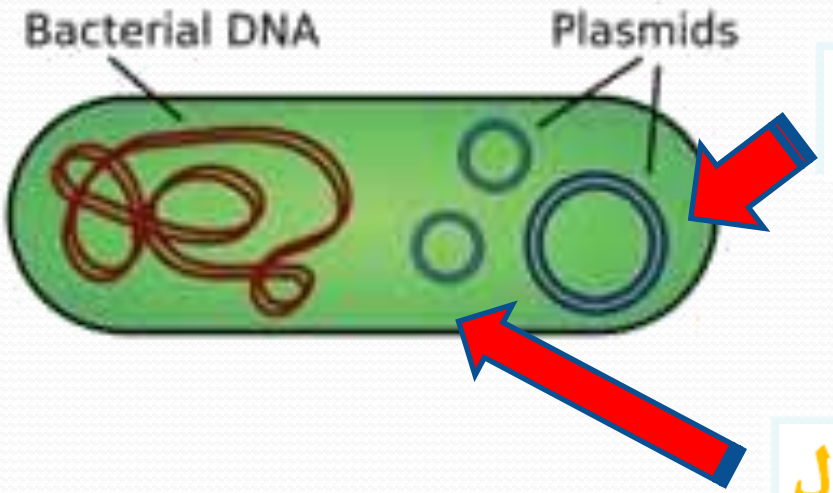


Recombinant DNA



Recombinant DNA

انواع پلاسمیدها



۱. پلاسمیدهای قابل انتقال

۲. پلاسمیدهای غیر قابل انتقال

nature

review article

Nature **263**, 731 - 738 (28 October 1976); doi:10.1038/263731a0

Transposable genetic elements and plasmid evolution

STANLEY N. COHEN*

*Address: Stanford University School of Medicine, Stanford, California 94305.

Transposable elements of DNA that are structurally defined and genetically discrete units seem to have an important role in the evolution of bacterial plasmids. Recombination occurring at the termini of such elements can result in the joining together of unrelated DNA segments that lack extensive nucleotide sequence homology. In addition, transposable elements serve as novel biological switches capable of turning on and off the expression of nearby genes as a consequence of their insertion into or excision from plasmid genomes.

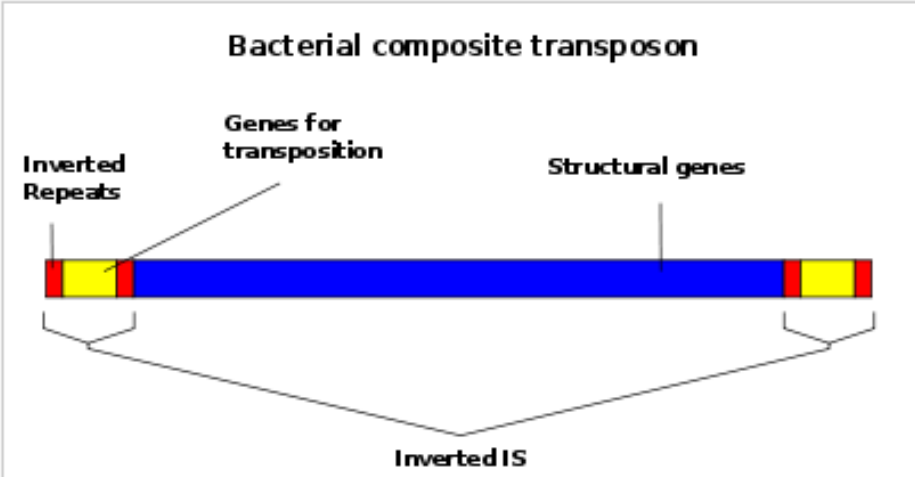
Jumping genes

ژنهای جهنده

Transposon

From Wikipedia, the free encyclopedia

Transposons are sequences of DNA that can move or **transpose** themselves to new positions within the genome of a single cell. The mechanism of transposition can be either "copy and paste" or "cut and paste". Transposition can create phenotypically significant mutations and alter the cell's genome size. Barbara McClintock's discovery of these **jumping genes** early in her career earned her a Nobel prize in 1983. [1]



A DNA composite transposon

Transposons make up a large fraction of the C-value of eukaryotic cells. Transposons are often considered "junk DNA". In *Oxytricha*, which has a unique genetic system, they play a critical role its development.[2]

Transposons are very useful to researchers as a means to alter DNA inside a living organism.

Barbara McClintock

Born	June 16, 1902 Hartford, Connecticut, USA
Died	September 2, 1992 (aged 90) Huntington, New York, USA
Nationality	American
Fields	Cytogenetics
Institutions	University of Missouri Cold Spring Harbor Laboratory
Alma mater	Cornell University
Known for	Work in genetic structure of maize
Notable awards	Nobel Prize in Physiology or Medicine (1983)

The Nobel Prize in Physiology or Medicine 1983

"for her discovery of mobile genetic elements"

Barbara McClintock delivering her Nobel Lecture at Karolinska Institutet in Stockholm, 8 December 1983.
Source: National Institutes of Health. Courtesy of the Barbara McClintock Papers, American Philosophical Society
Photographer unknown

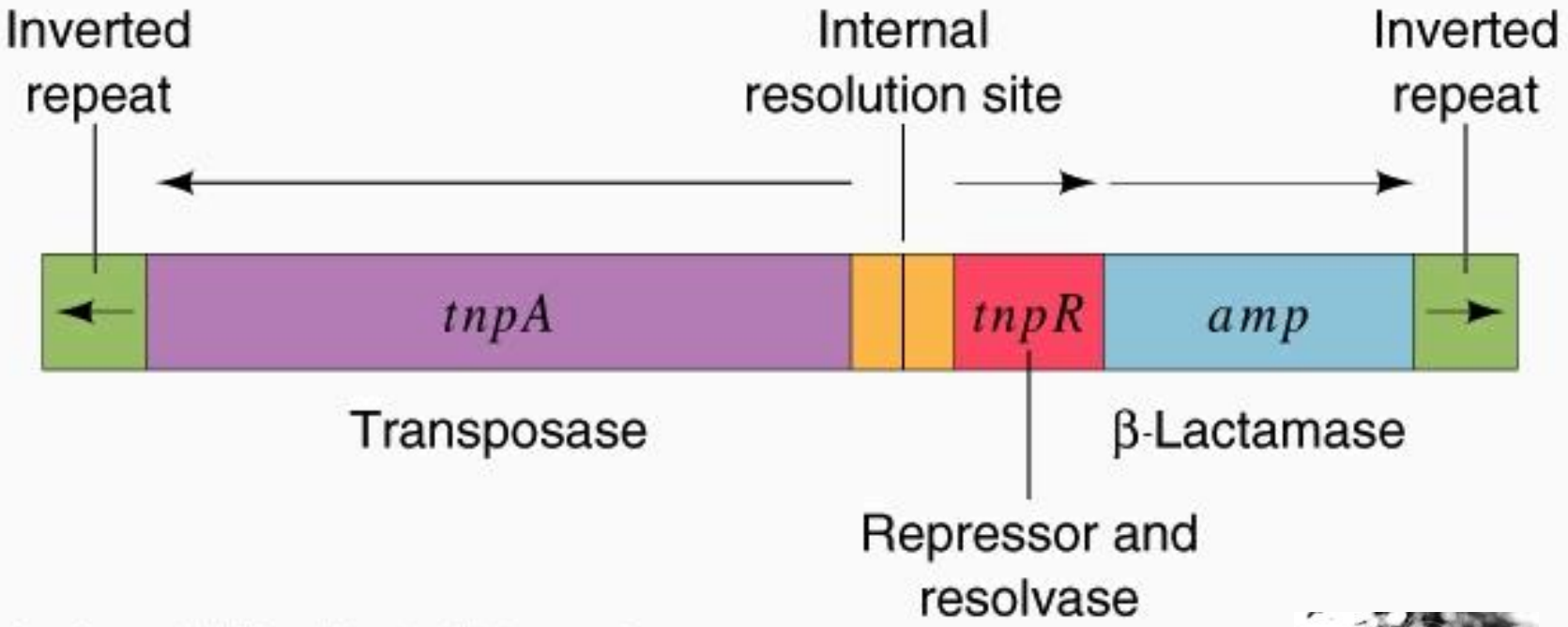
Barbara McClintock

USA

Cold Spring Harbor Laboratory
Cold Spring Harbor, NY, USA

b. 1902
d. 1992

Mobile DNA

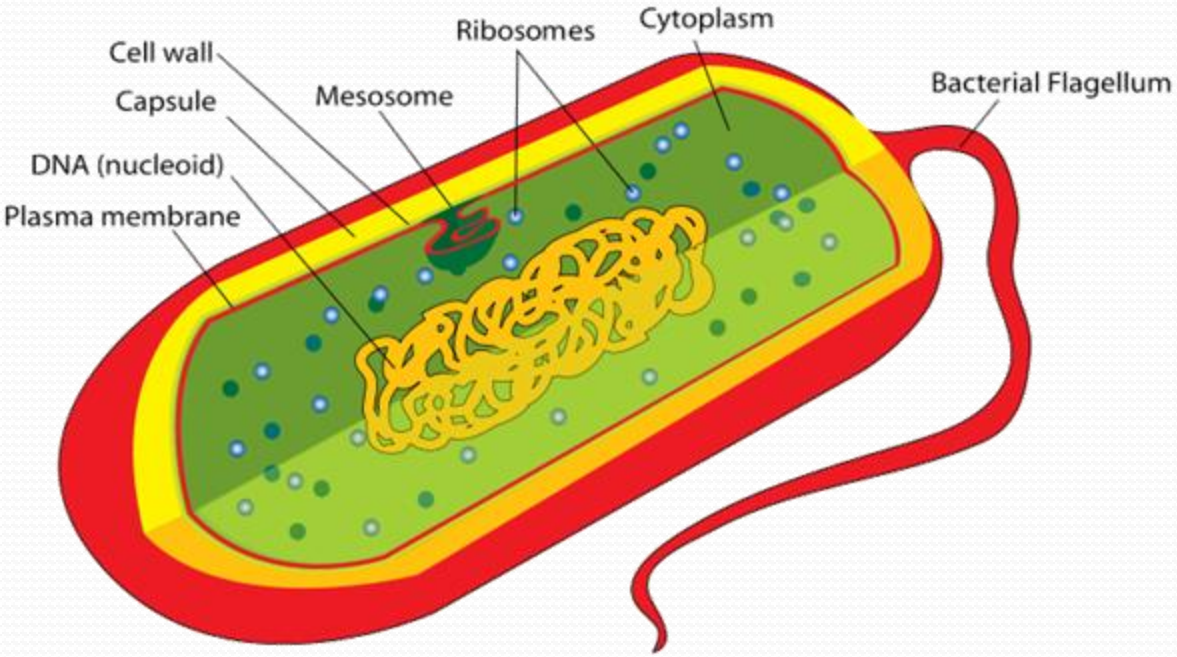


Barbara McClintock

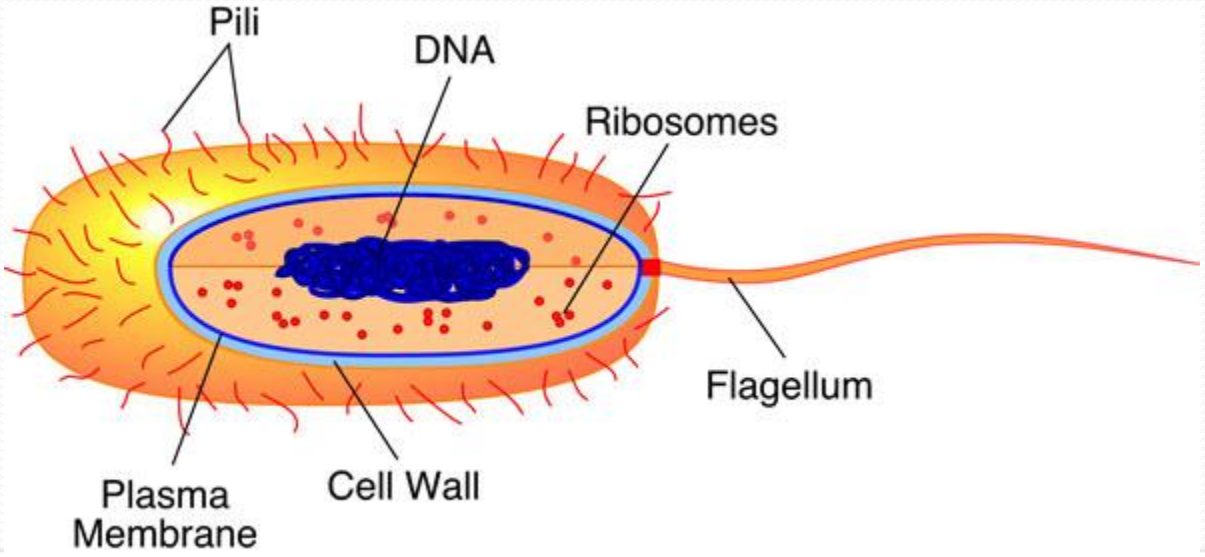
The Nobel Prize in Physiology or Medicine 1983

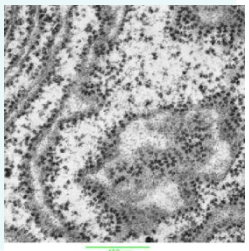
سیتوپلاسم

- سیتوپلاسم فضای سیال مایع مانند داخلی سلول است که توسط غشاء سلولی احاطه شده است.
- سیتوپلاسم بطور عمده از آب، مولکولهای آلی و معدنی، ریبوزومها، دی ان آ و انکلوزیونها تشکیل شده است.



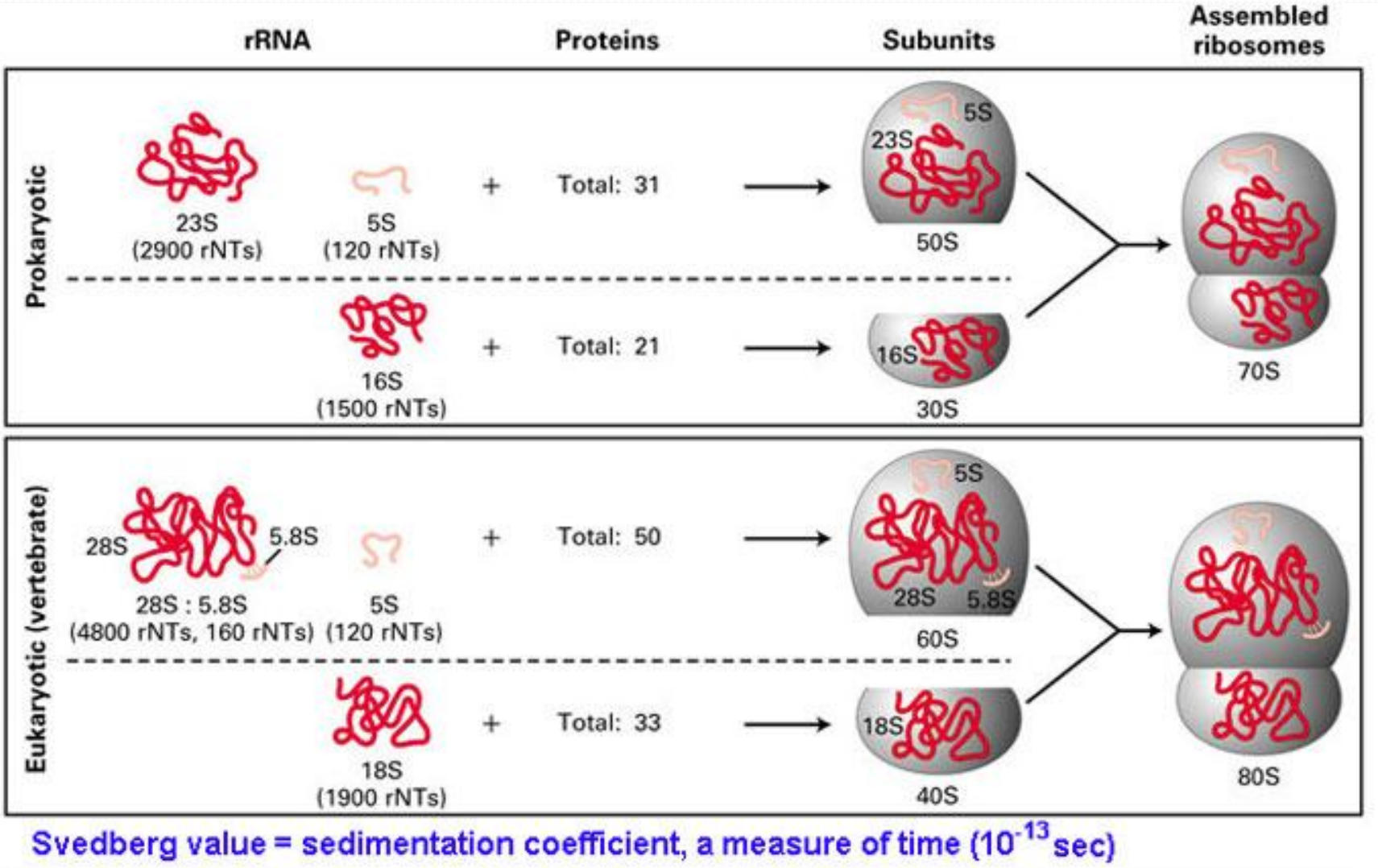
ریبوزوم


Pili
DNA
Ribosomes
Flagellum
Plasma Membrane
Cell Wall



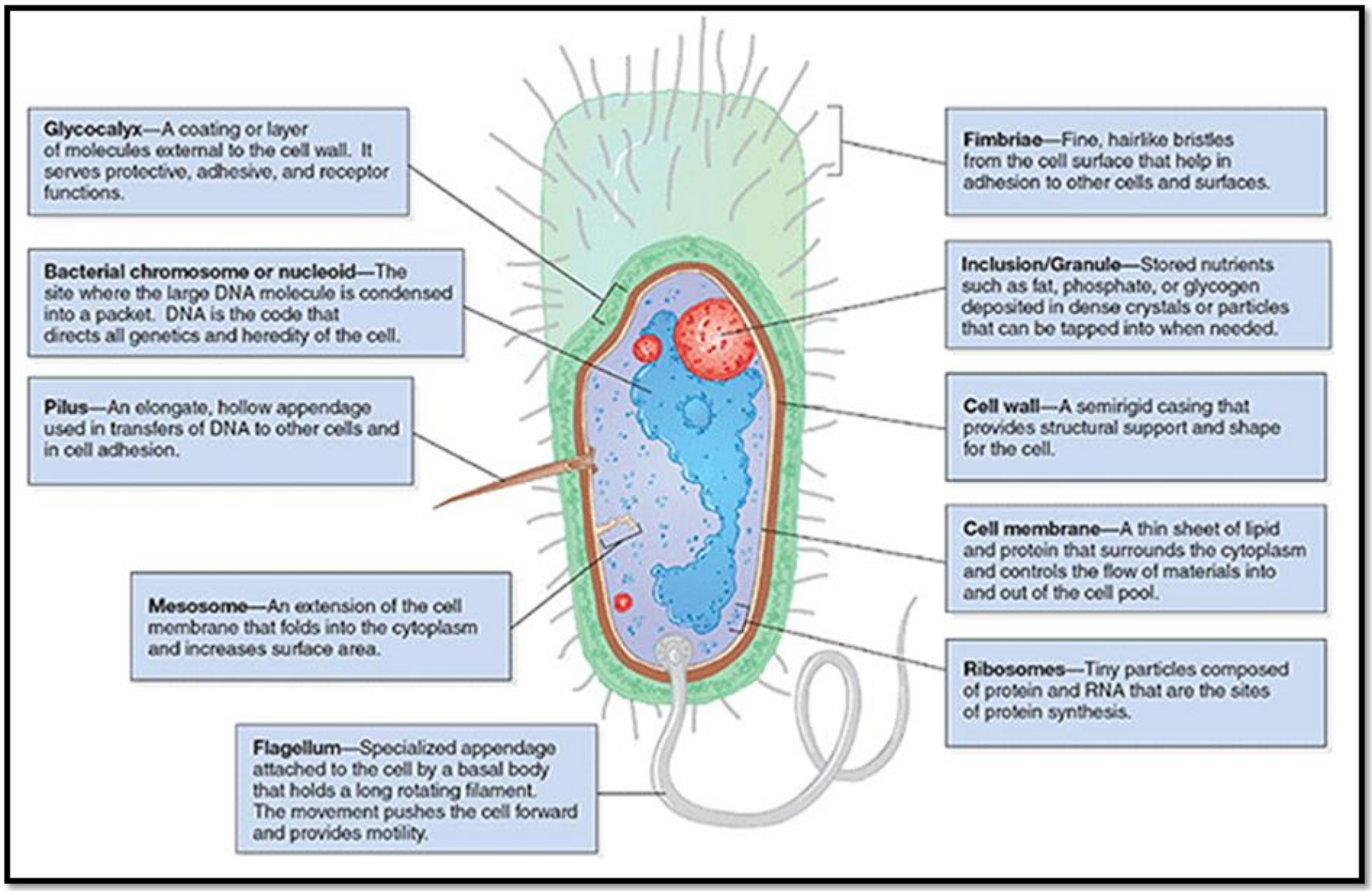
30S
+
50S
50S
30S
(a) Small subunit
(b) Large subunit
(c) Complete 70S ribosome

مقایسه ریبوزومها در سلول یوکاریوت و پروکاریوت

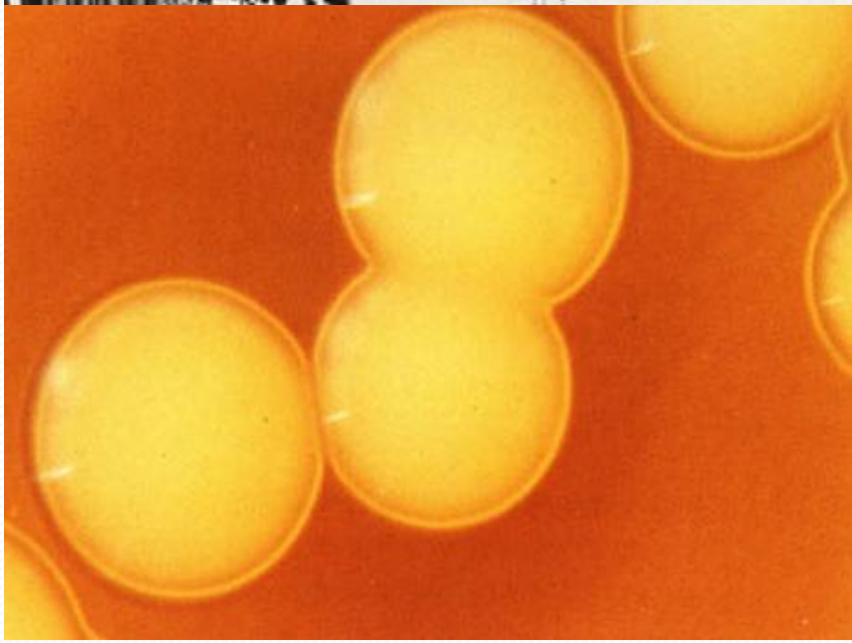


Svedberg value = sedimentation coefficient, a measure of time (10^{-13} sec)

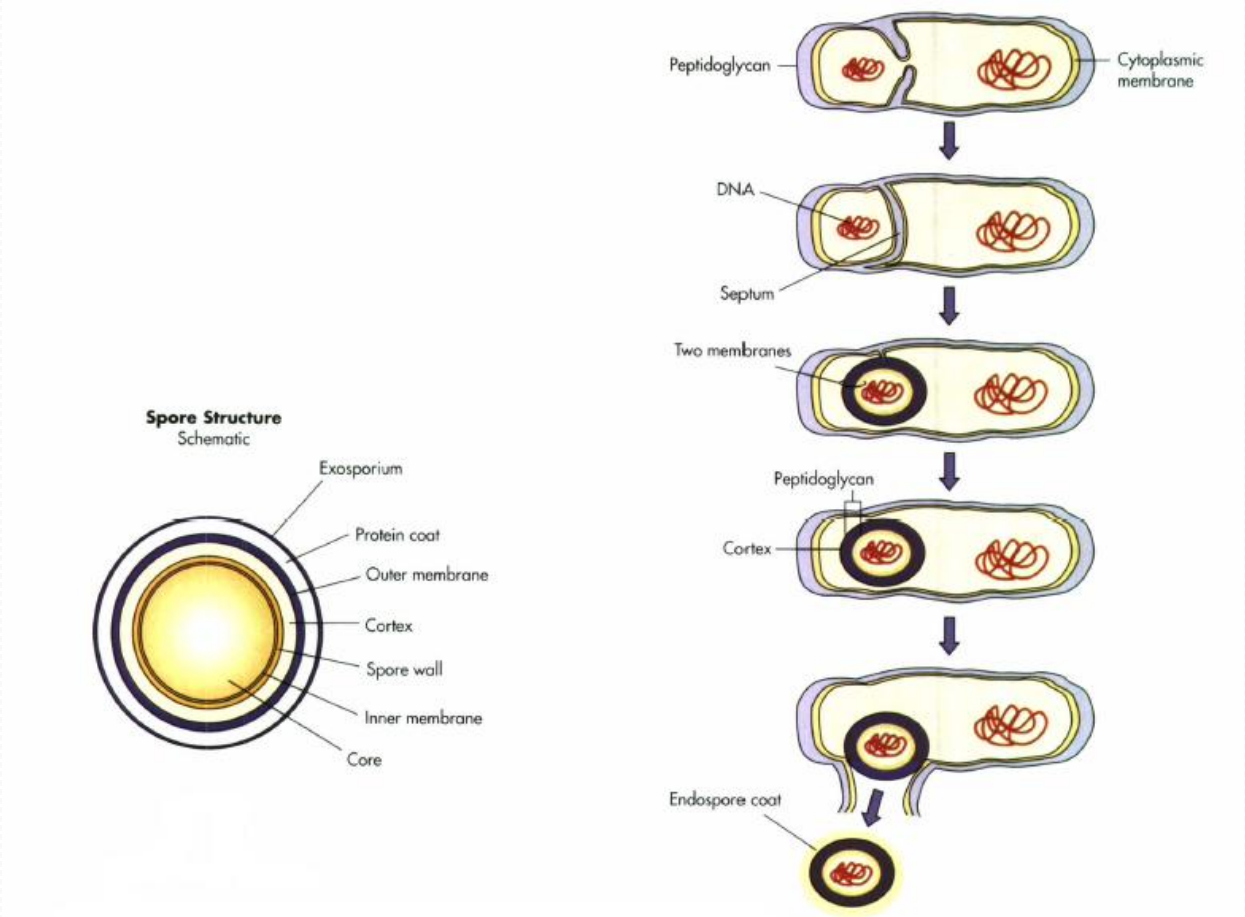
ساختار باکتری



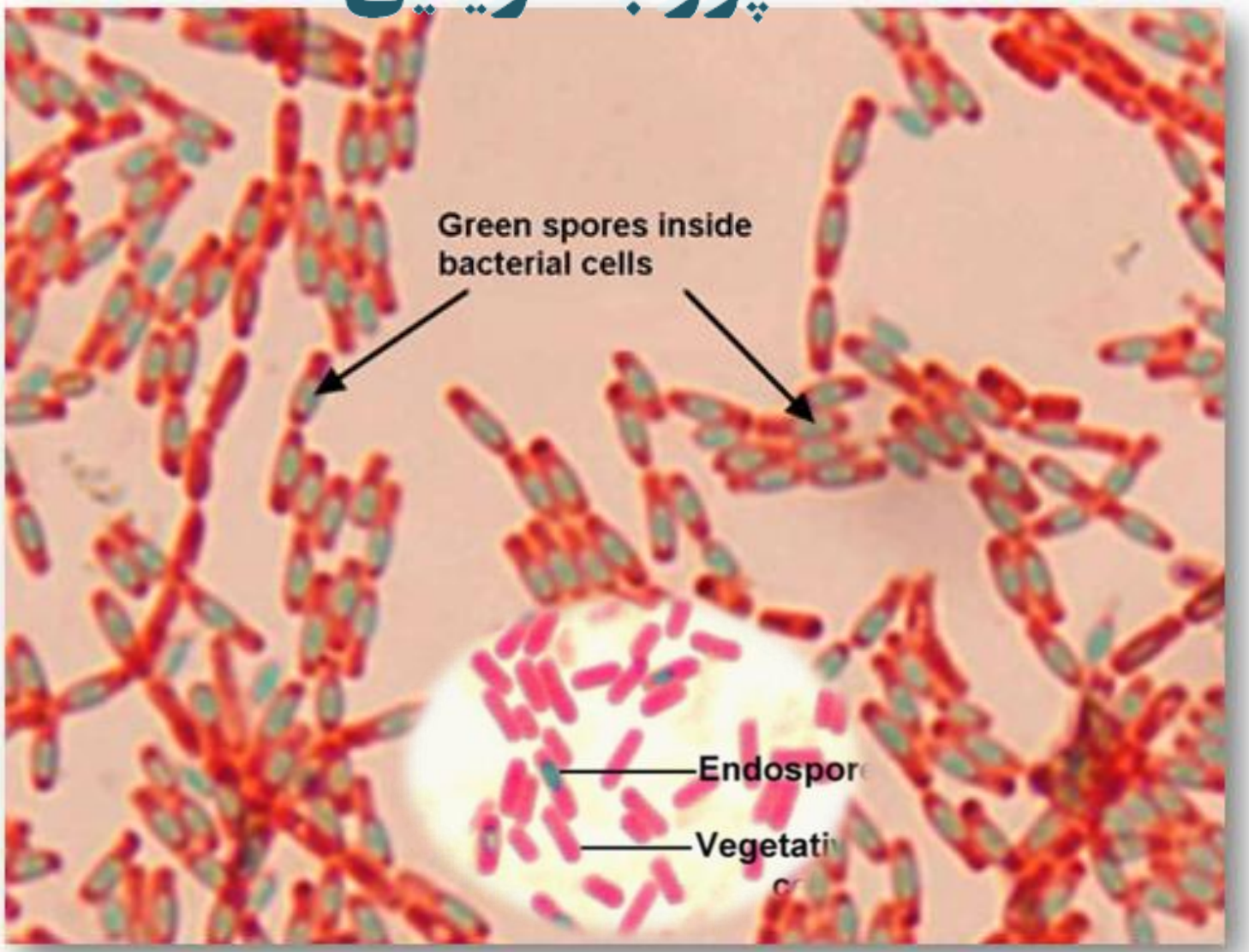
Colonies



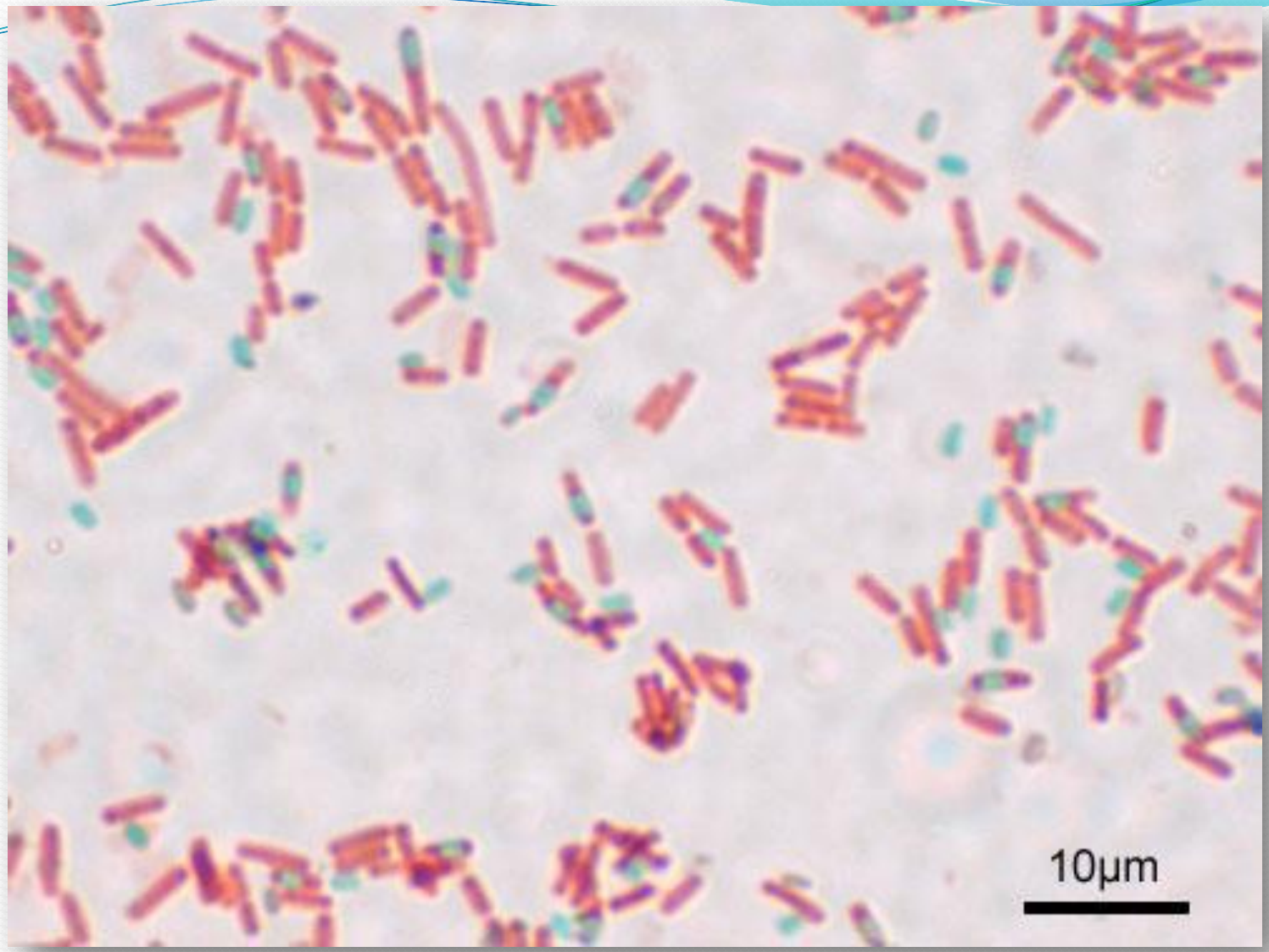
Spores


Spore Structure
Schematic
Exosporium
Protein coat
Outer membrane
Cortex
Spore wall
Inner membrane
Core
Peptidoglycan
Cytoplasmic membrane
DNA
Septum
Two membranes
Peptidoglycan
Cortex
Endospore coat

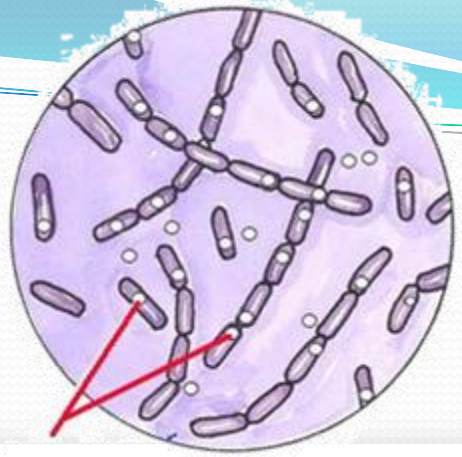
اسپور باکتریایی

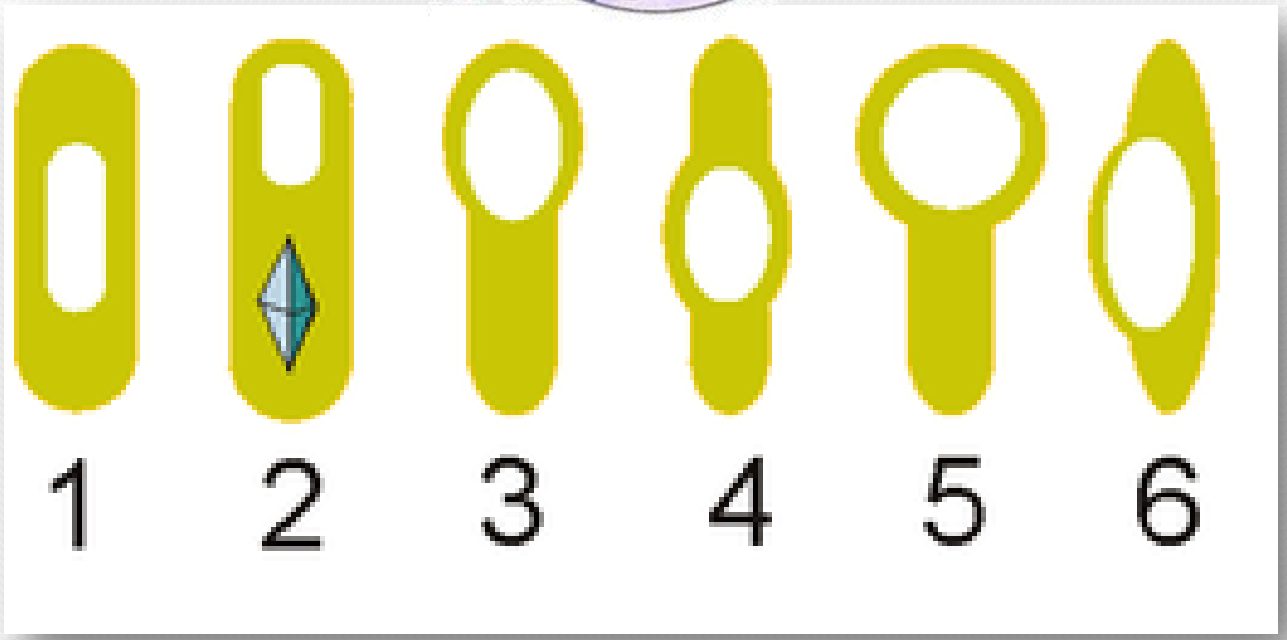


ENDOSPORE



اسپور باکتریایی

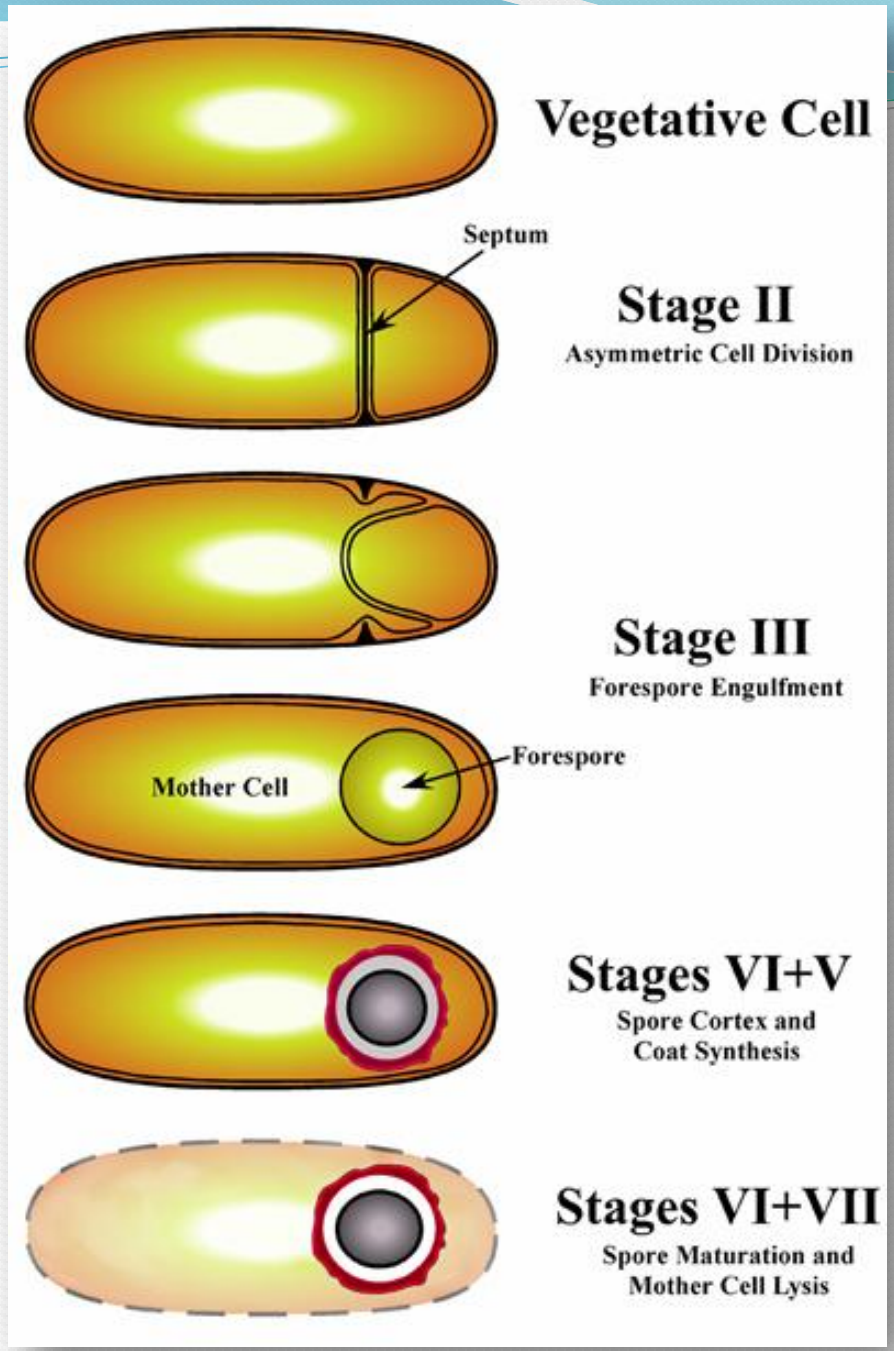


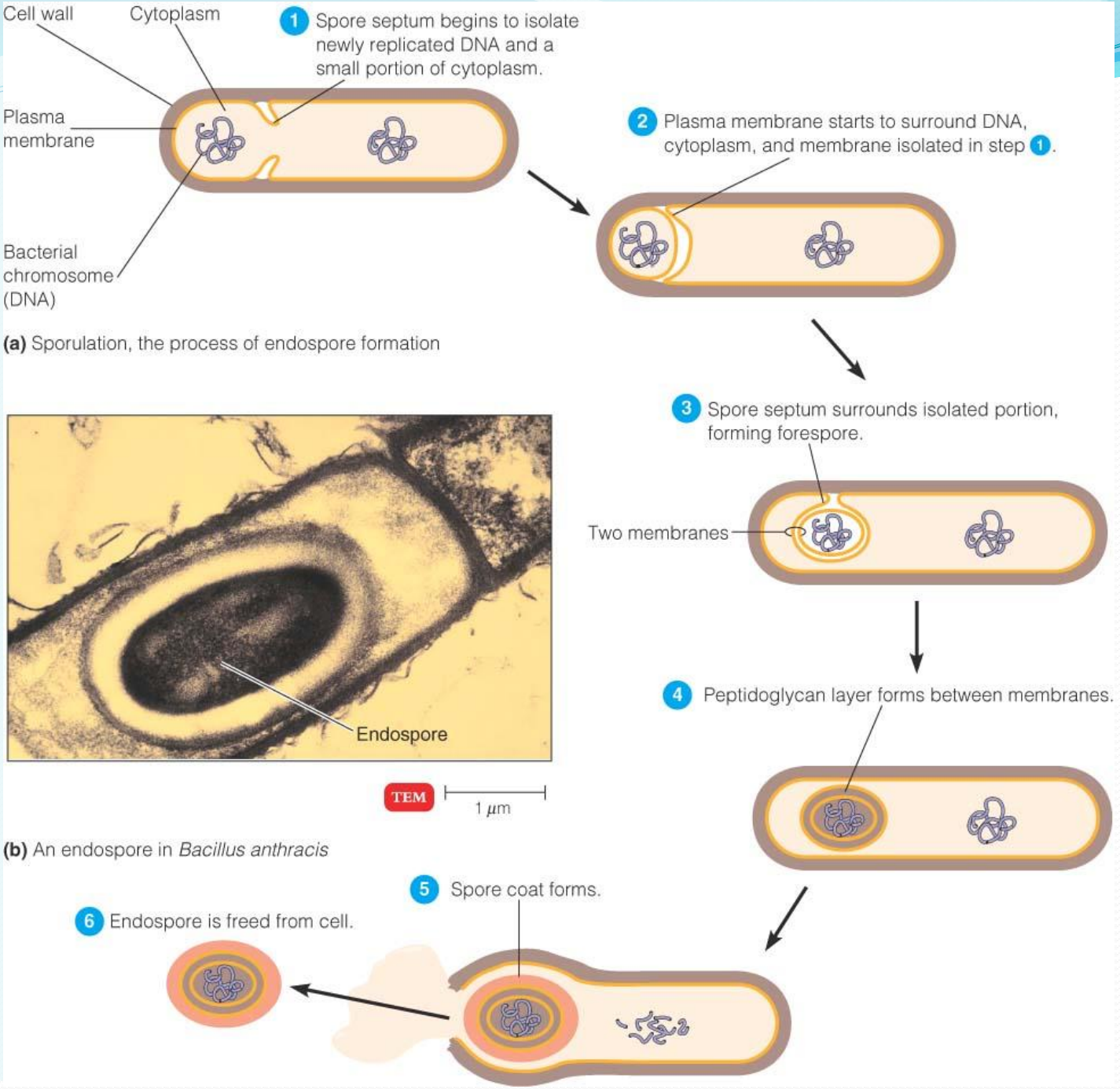


(1, 4) central endospore

(2, 3, 5) terminal endospore

(6) lateral endospore

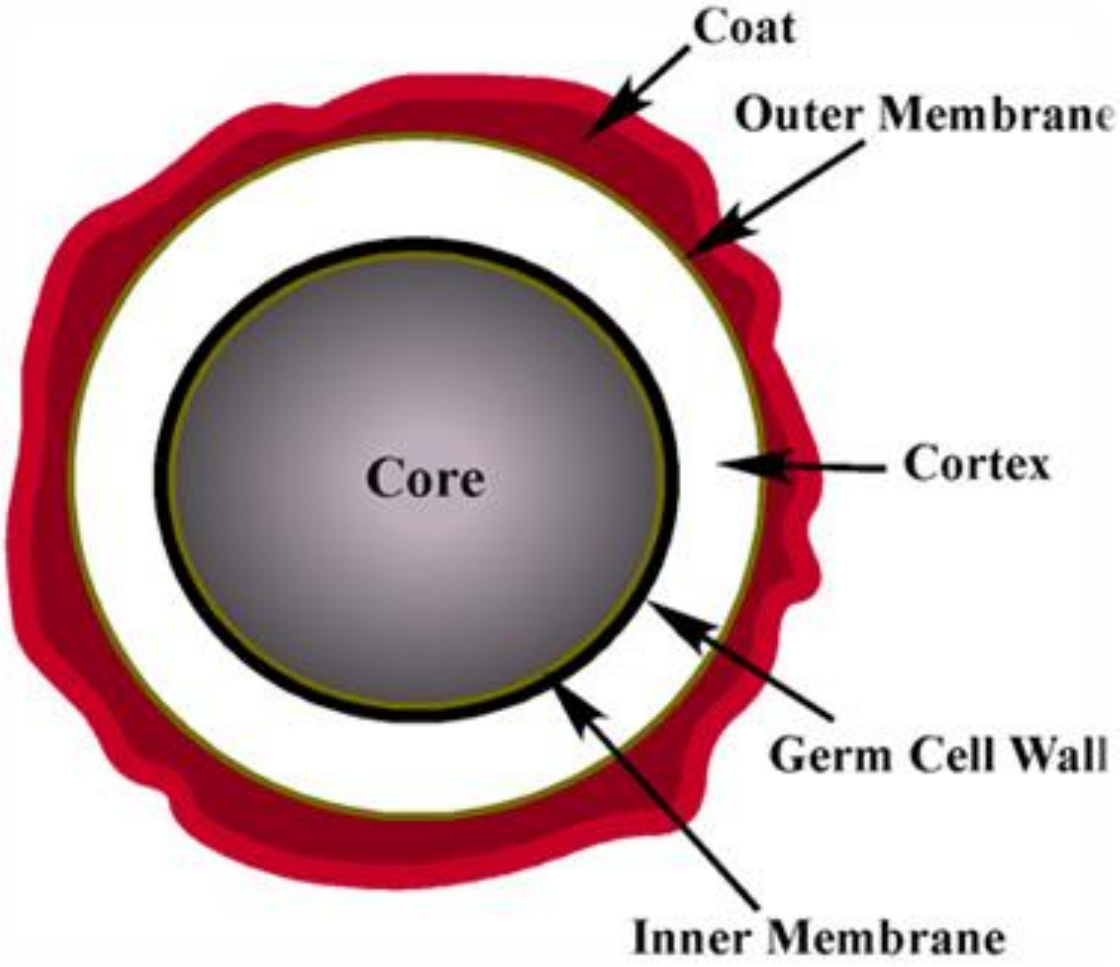

Vegetative Cell
Septum
Stage II
Asymmetric Cell Division
Stage III
Forespore Engulfment
Mother Cell
Forespore
Stages VI+V
Spore Cortex and
Coat Synthesis
Stages VI+VII
Spore Maturation and
Mother Cell Lysis



(a) Sporulation, the process of endospore formation

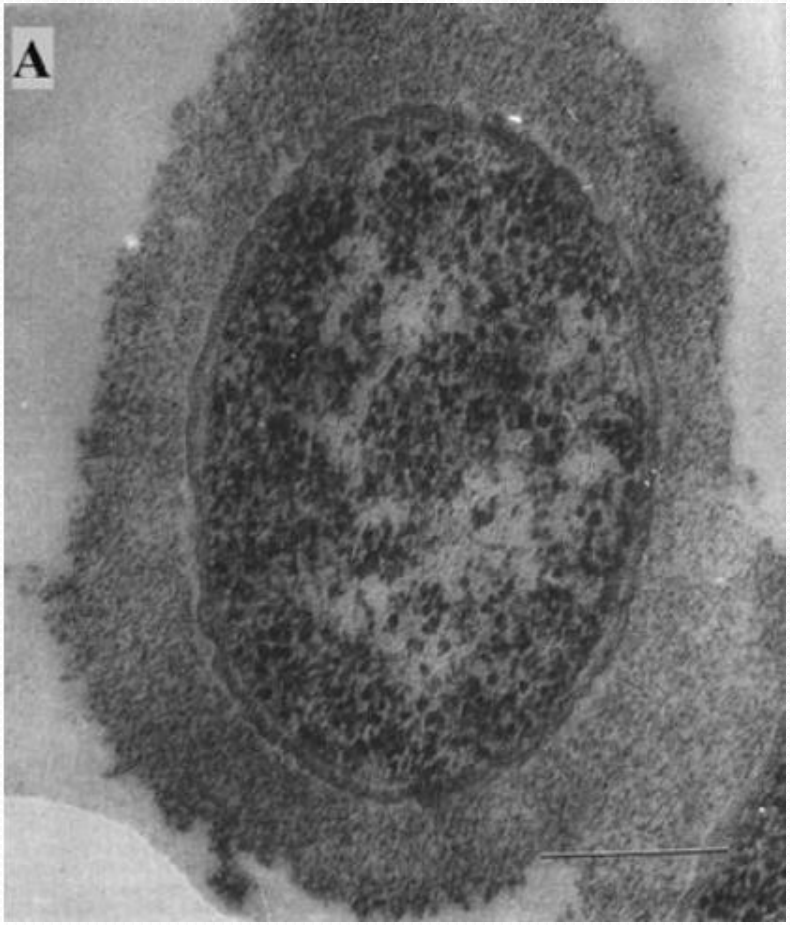
(b) An endospore in *Bacillus anthracis*

اسپور باکتریایی

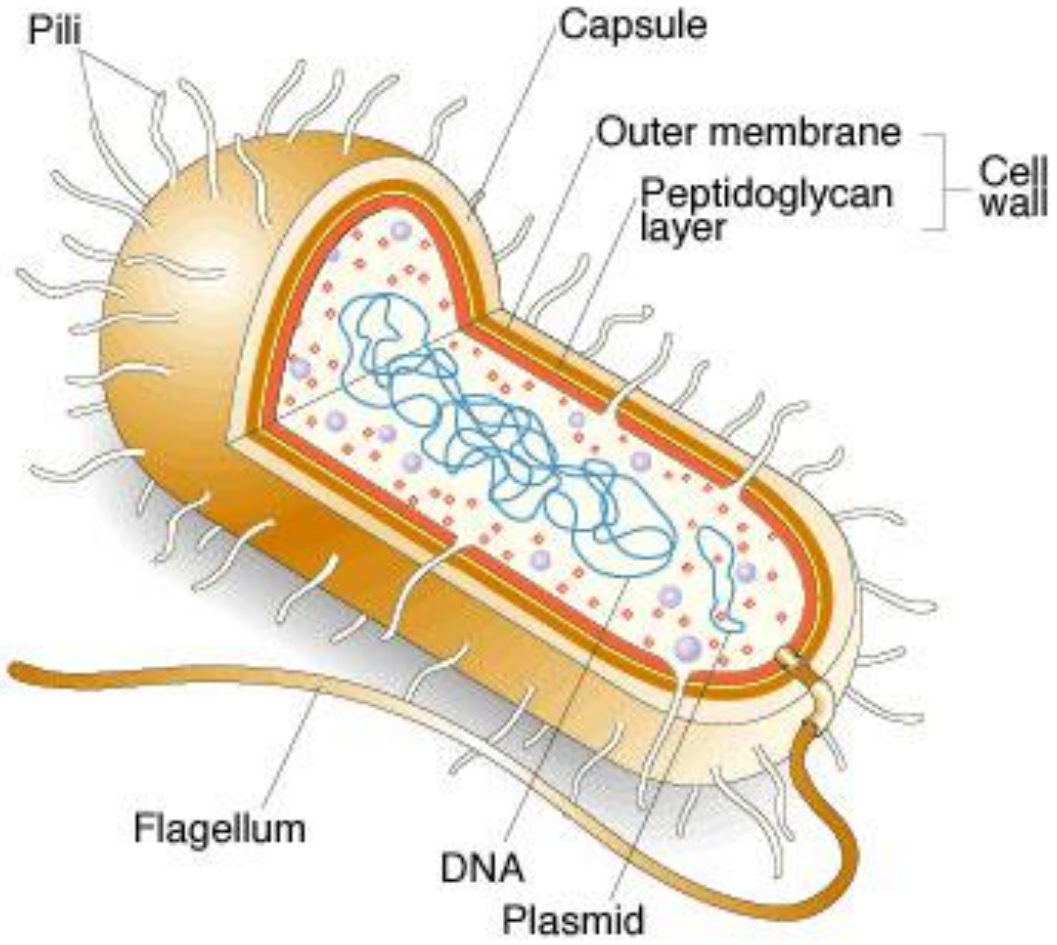


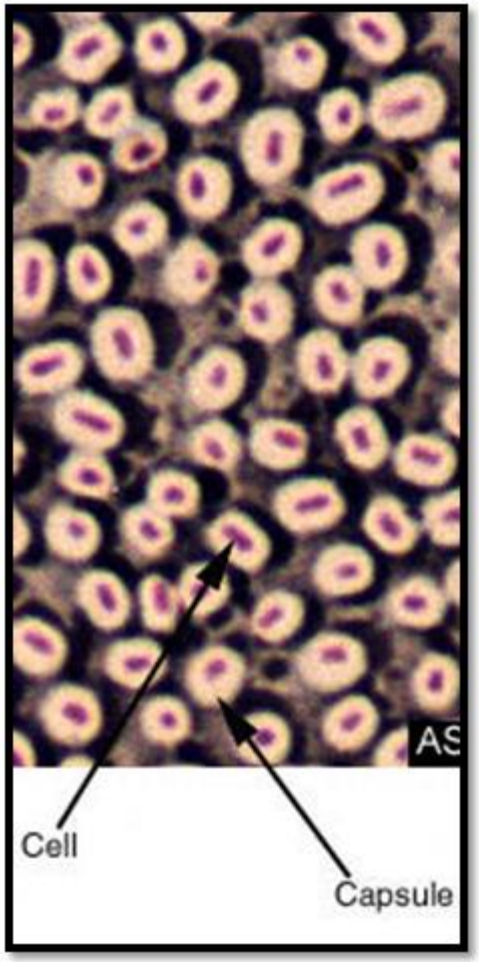
Capsule & Slime

- Capsule
  - Dry inhibits
  - Antigenic properties
  - Phagocytosis inhibits
  - Attaches
  - Shape
- Slime
  - Dry inhibits
  - Antigenic properties
  - Phagocytosis inhibits
  - Attaches

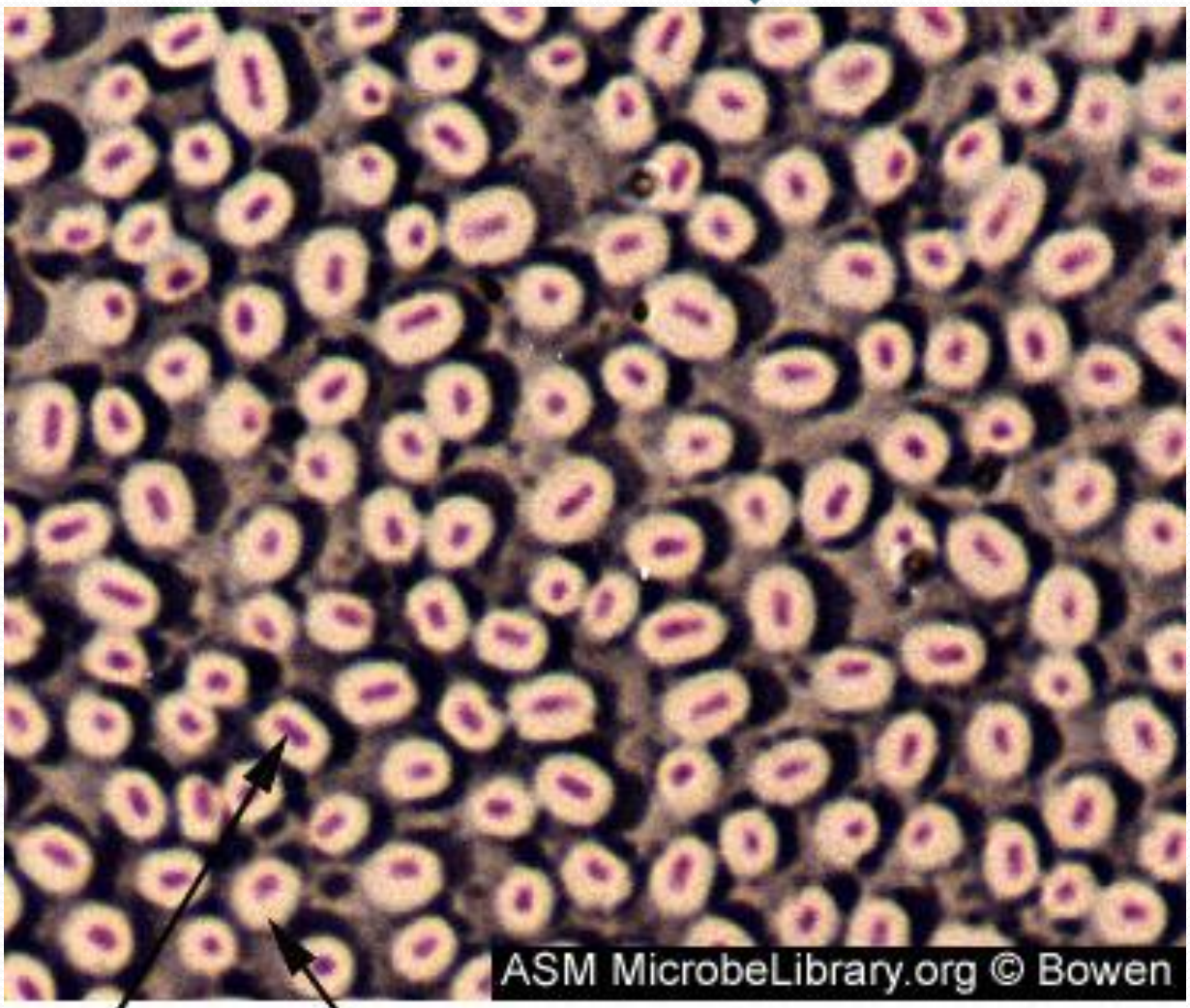


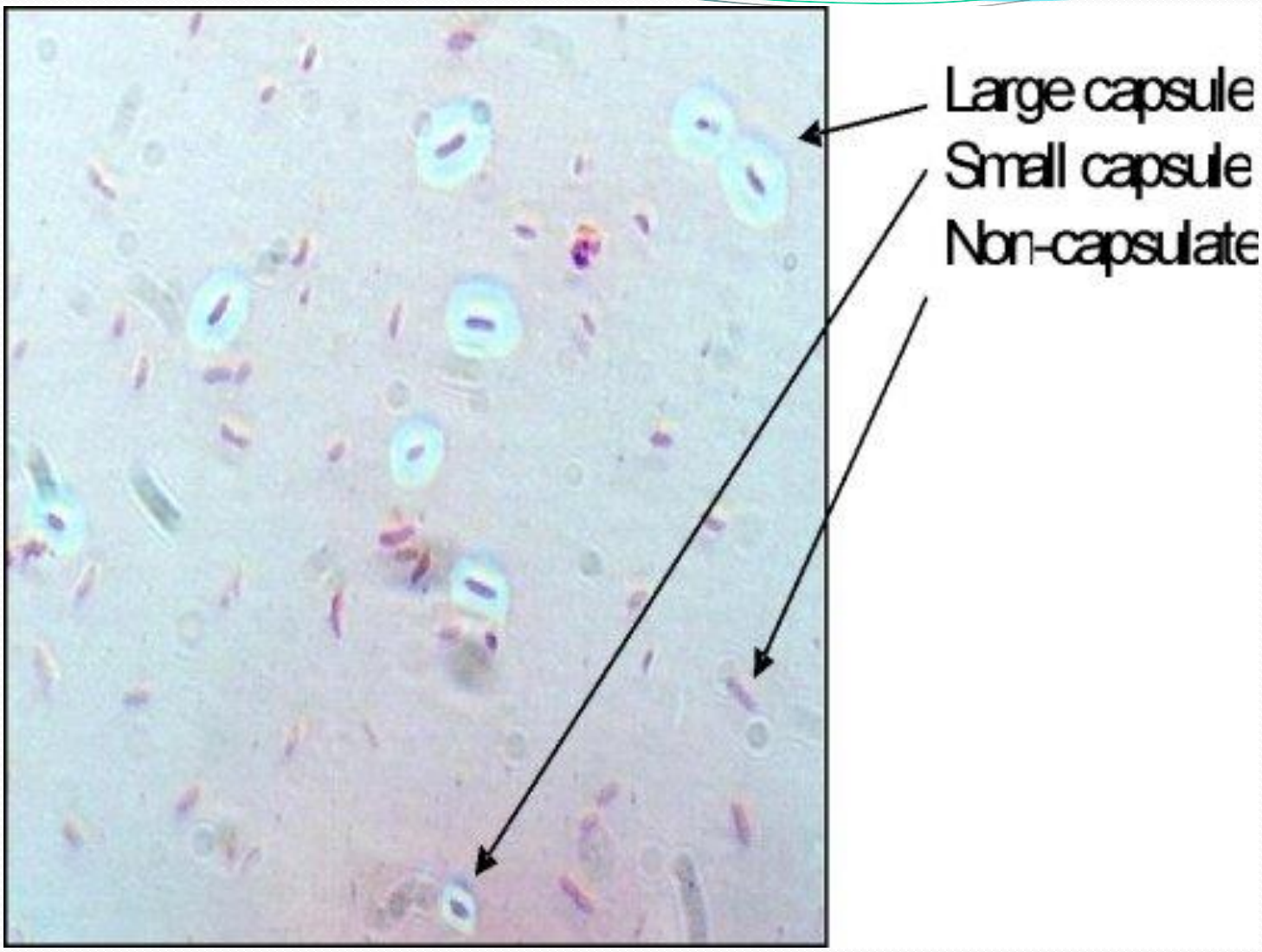
کپسول


Pili
Capsule
Outer membrane
Peptidoglycan layer
Cell wall
Flagellum
DNA
Plasmid

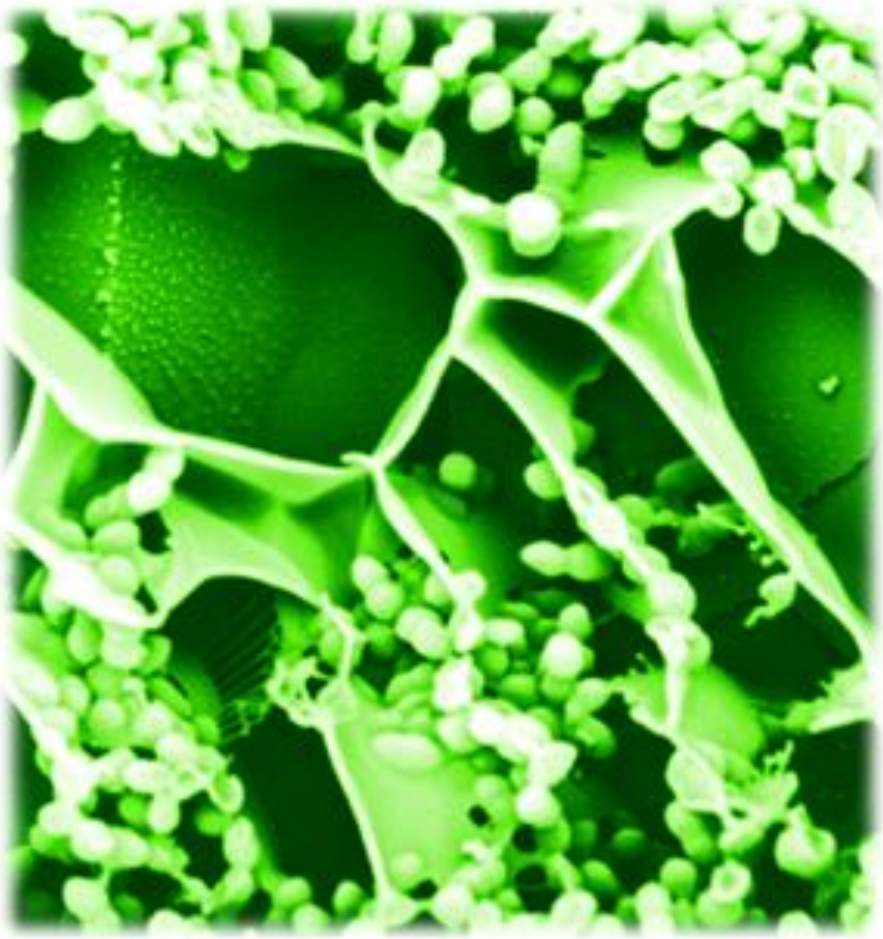

Cell
Capsule

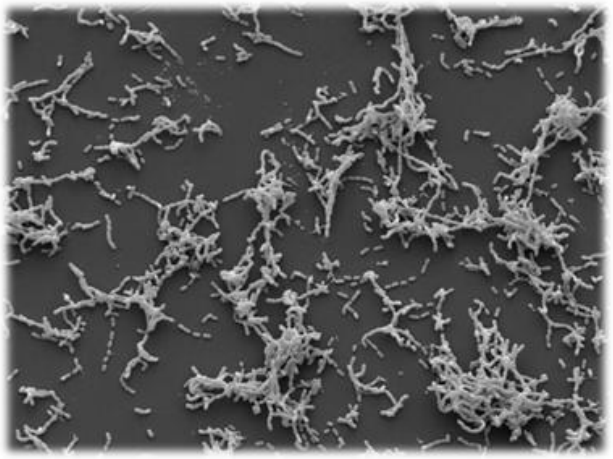
کپسول



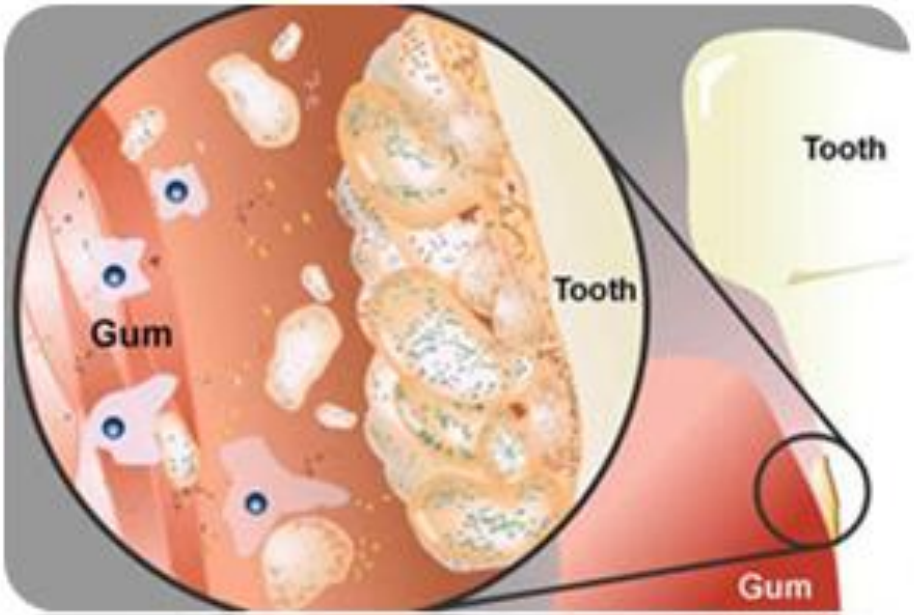


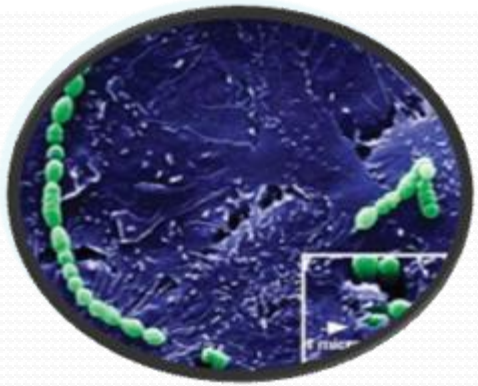
کپسول در باکتروئیدز فراژیلیس

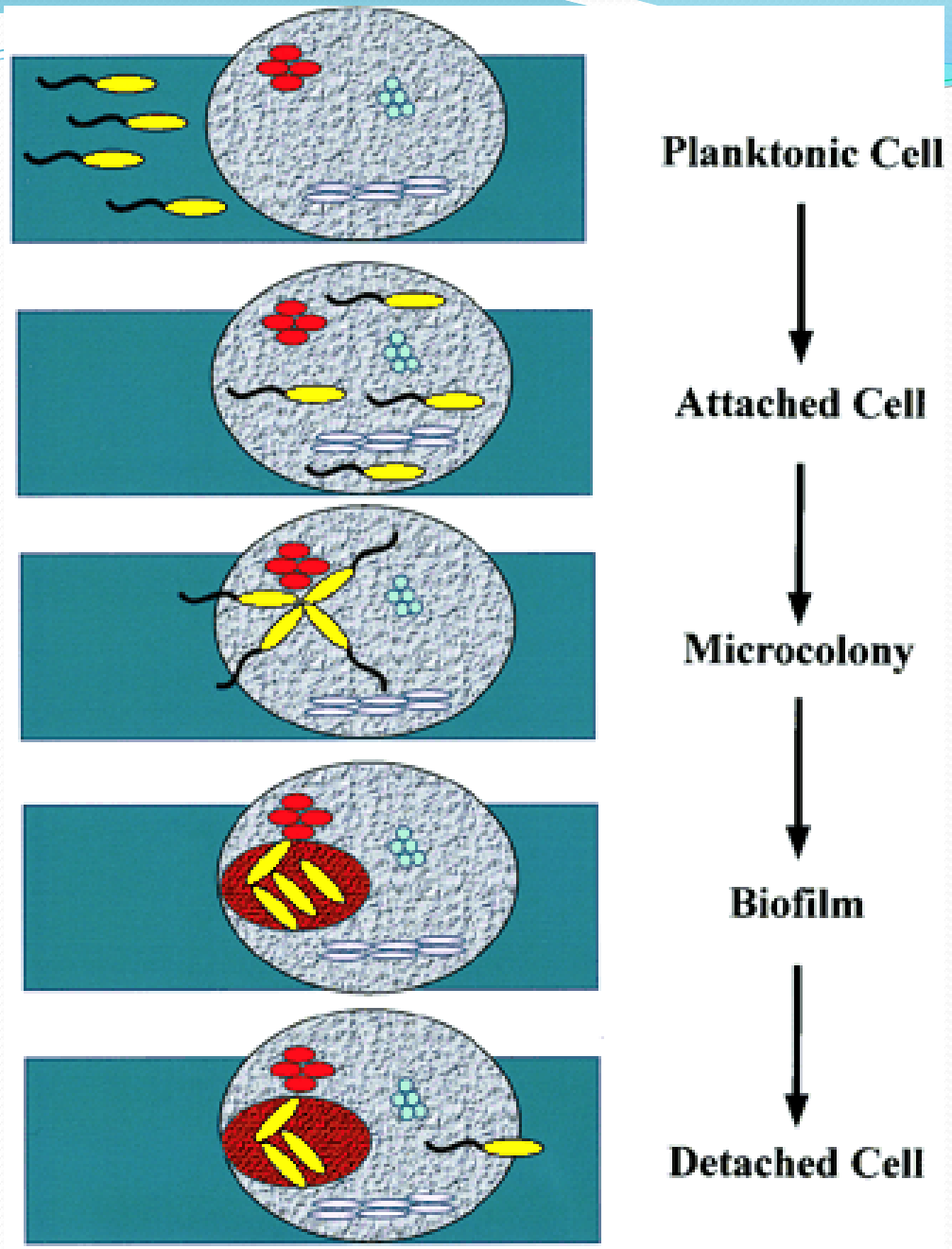




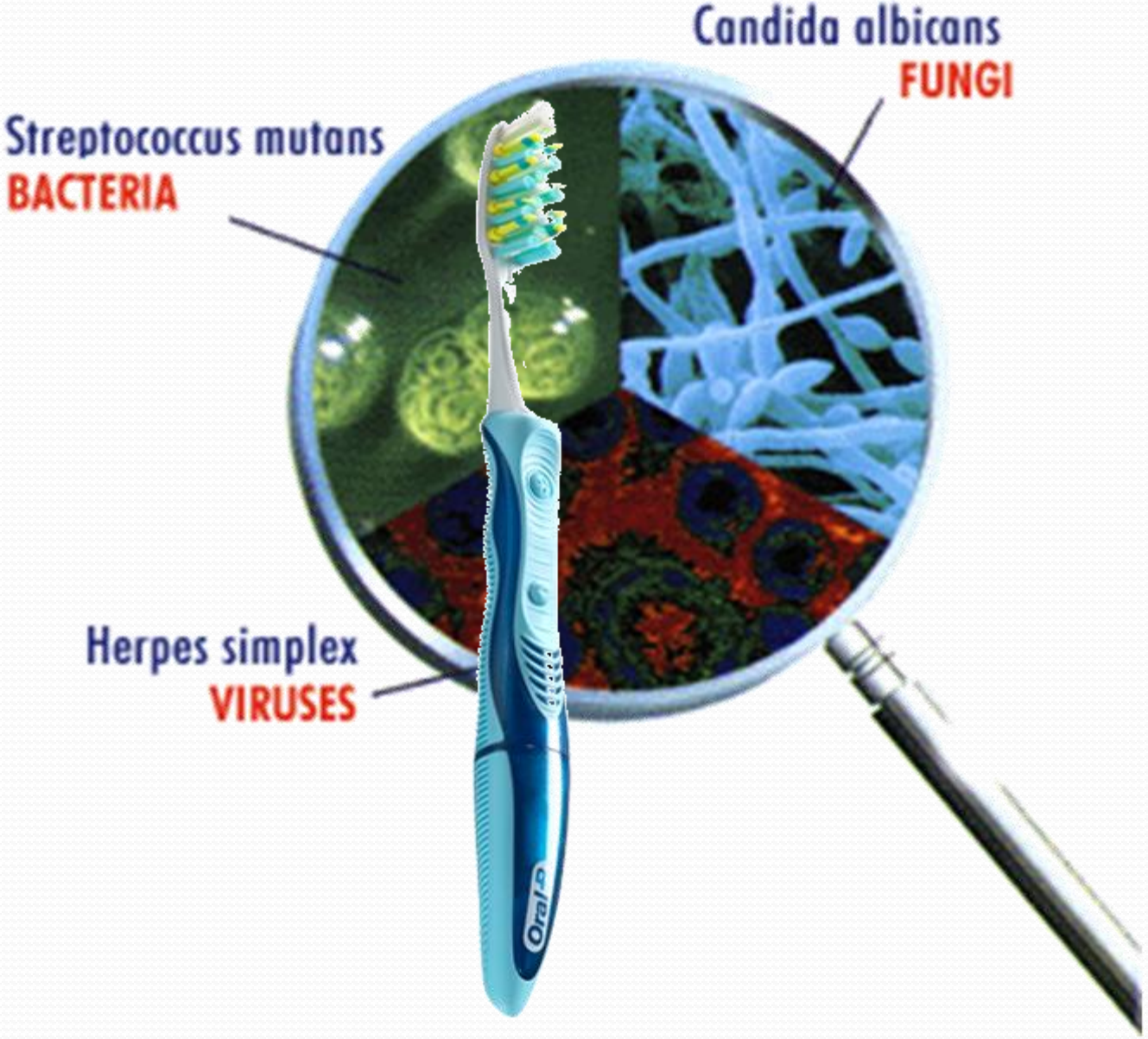
گلیکوکالیکس (لایه لزج)


Tooth
Tooth
Gum
Gum




Planktonic Cell
Attached Cell
Microcolony
Biofilm
Detached Cell


BACTERIA
FUNGI
VIRUSES
آلودگی میکروبی

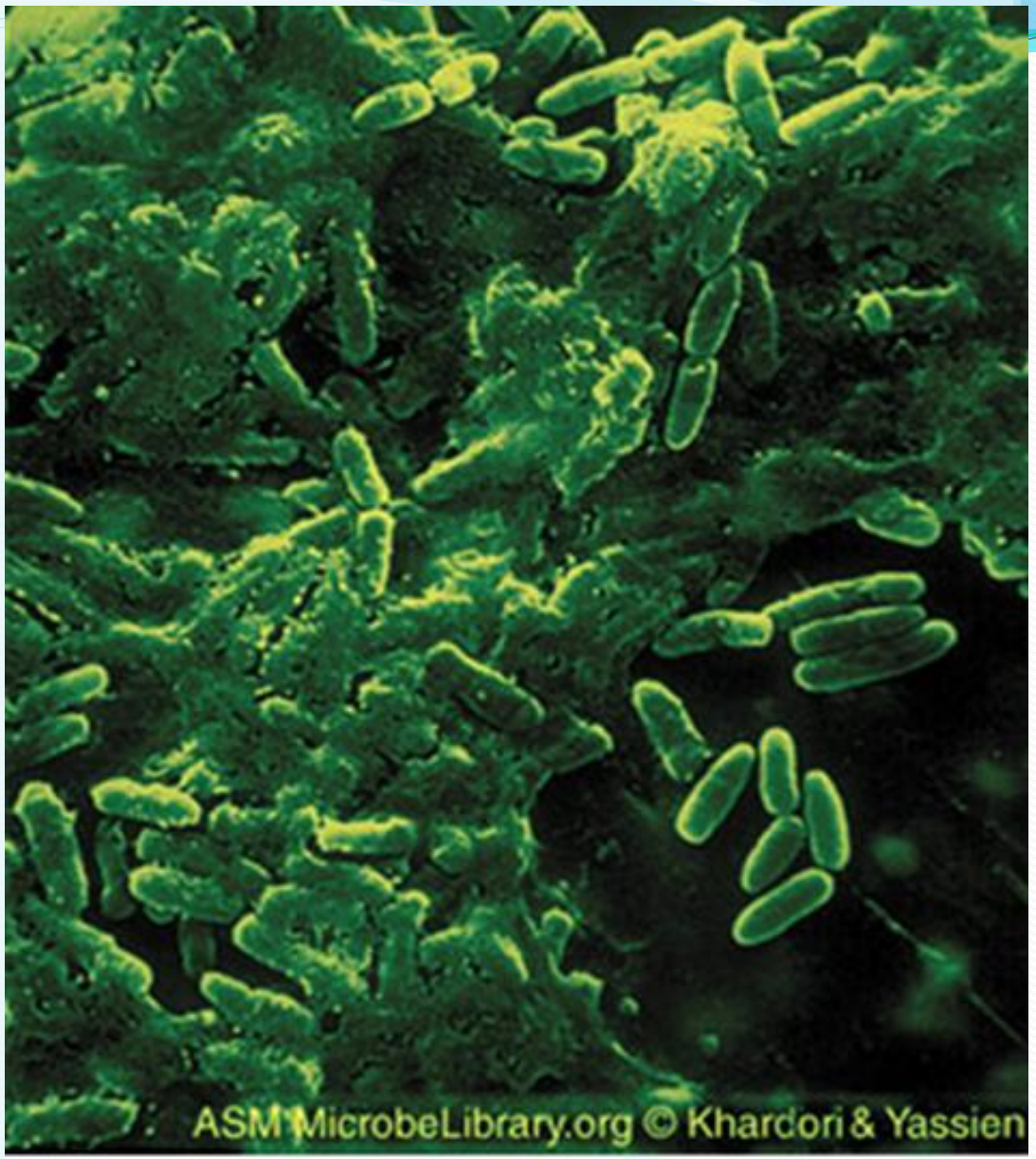

Candida albicans
FUNGI
Streptococcus mutans
BACTERIA
Herpes simplex
VIRUSES

Steryl Brush Tabs™

The problem with toothbrushes

EVERY TOOTHBRUSH harbours millions of micro-organisms that can potentially initiate or transmit disease. Already after the first teeth brushing, bacteria, fungi and viruses that are present on teeth plaque will attach on the toothbrush. Not only the bristle ends but also the toothbrush 'head' and mid portion, often composed of porous synthetic materials, will harbour these micro-organisms that will penetrate the porous toothbrush material and build-up biofilm, a threedimensional protective gel in which they multiply.

Parts of a toothbrush that can become contaminated with micro-organisms



Scanning electron microscopy of biofilm present on toothbrush bristles

Oral Bacteria & Dental Caries

What Causes Cavities? Microbes, Biofilms, Plaque & Tooth Decay

Jun 23, 2008 Tami Port

Biofilm of Dental Plaque - *Dozenist Wiki*

Dental caries or cavities are caused by acidic metabolites produced by bacteria that normally inhabit the mouth, where they feed on carbohydrates.

These prokaryotes (particularly Gram-positive bacteria such as *Lactobacillus spp.*, *Streptococcus mutans*, and *Actinomyces spp.*) exist in oral biofilms; the sticky, slimy coating in the mouth that is most noticeable before brushing away that bad morning breath.

What Is Plaque?

Dental plaque is a biofilm of material that adheres to, and can build up on, teeth; a living slime layer made of millions of bacterial cells, salivary polymers, and bacterial wastes and other extracellular products. Unchecked, this biofilm can easily reach a thickness of hundreds of cells on the surfaces of the teeth, and, over time, plaque build-up can become mineralized, eventually forming calculus (tartar).

Bacteria, Not Sugar, Causes Cavities

Especially as children, we've all been told that if we eat too many sweets we'll get cavities. This leads to the misconception that the sugar is directly causing holes to develop in our teeth. This is not specifically how tooth

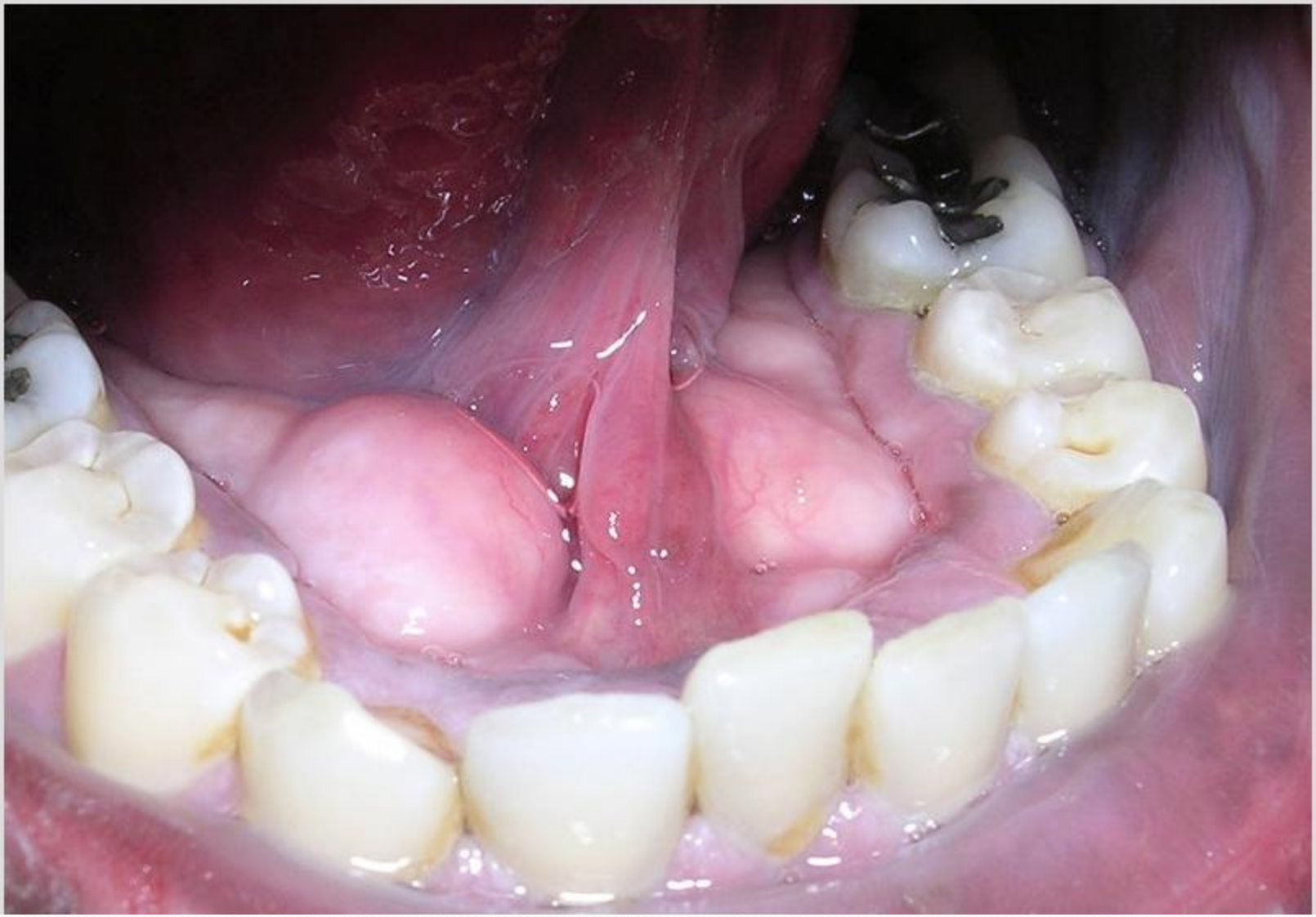
suite101.com
Insightful writers. Informed readers.

Biofilm of Dental Plaque

Credit: Dozenist Wiki

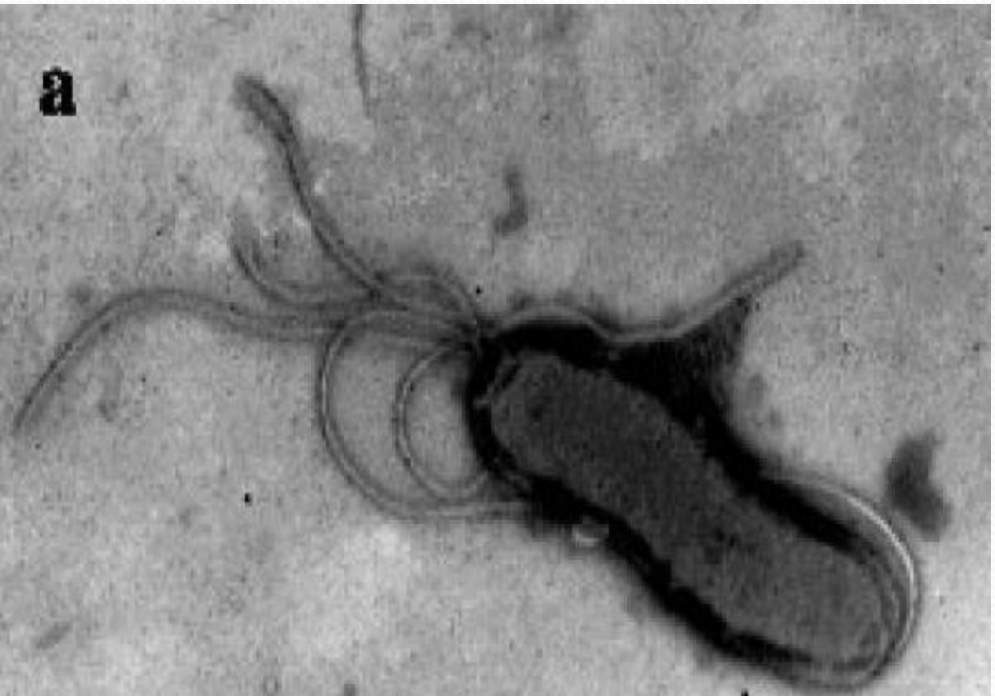
article: Oral Bacteria & Dental Caries

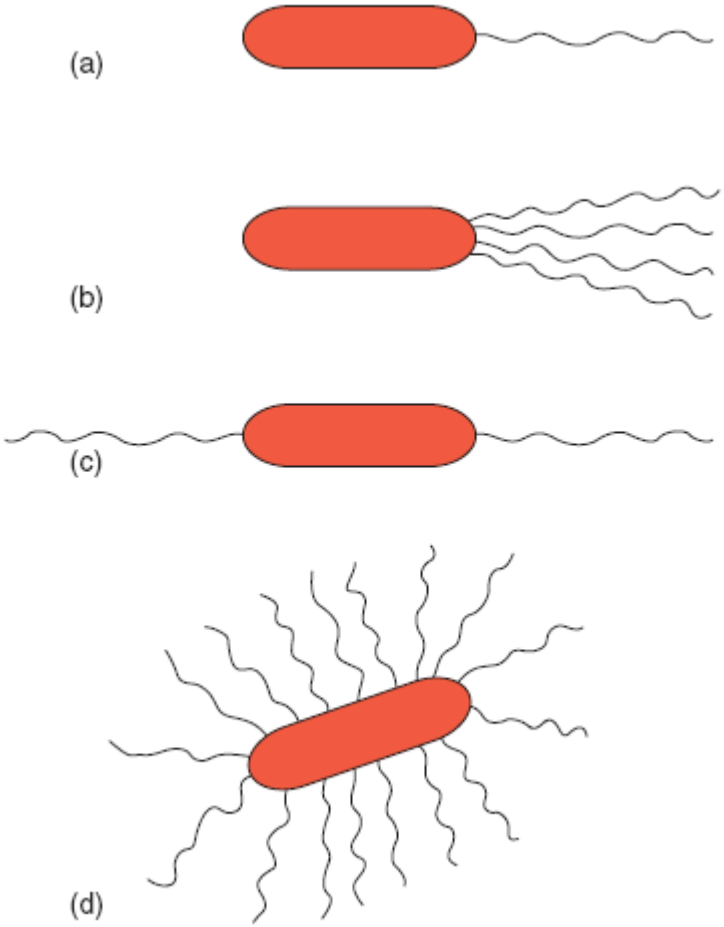
Other images from this articl



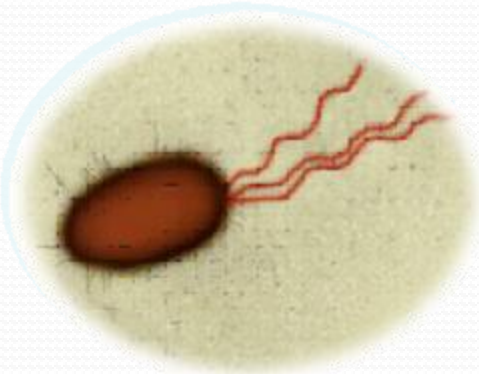
Flagella

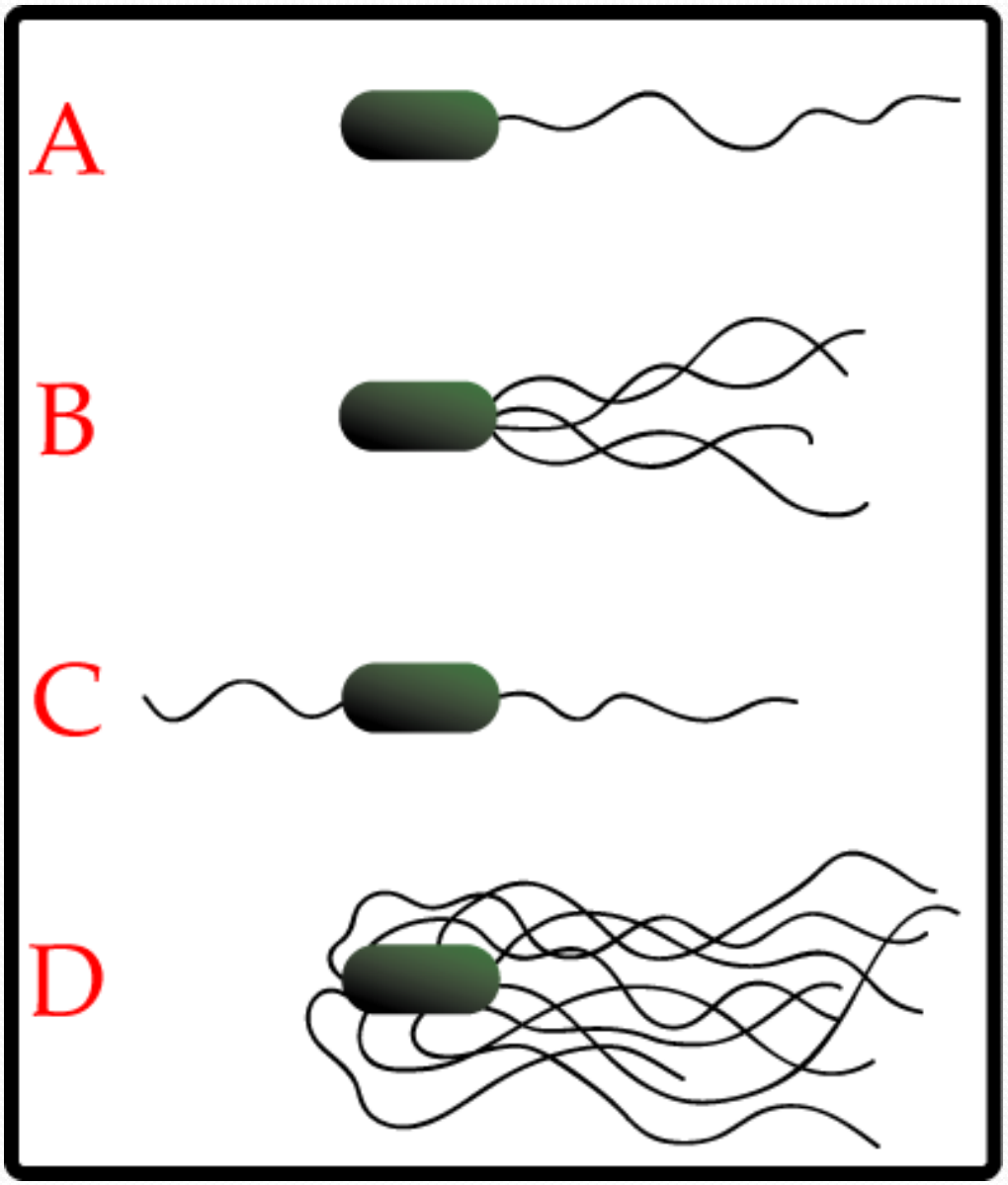
- Motility

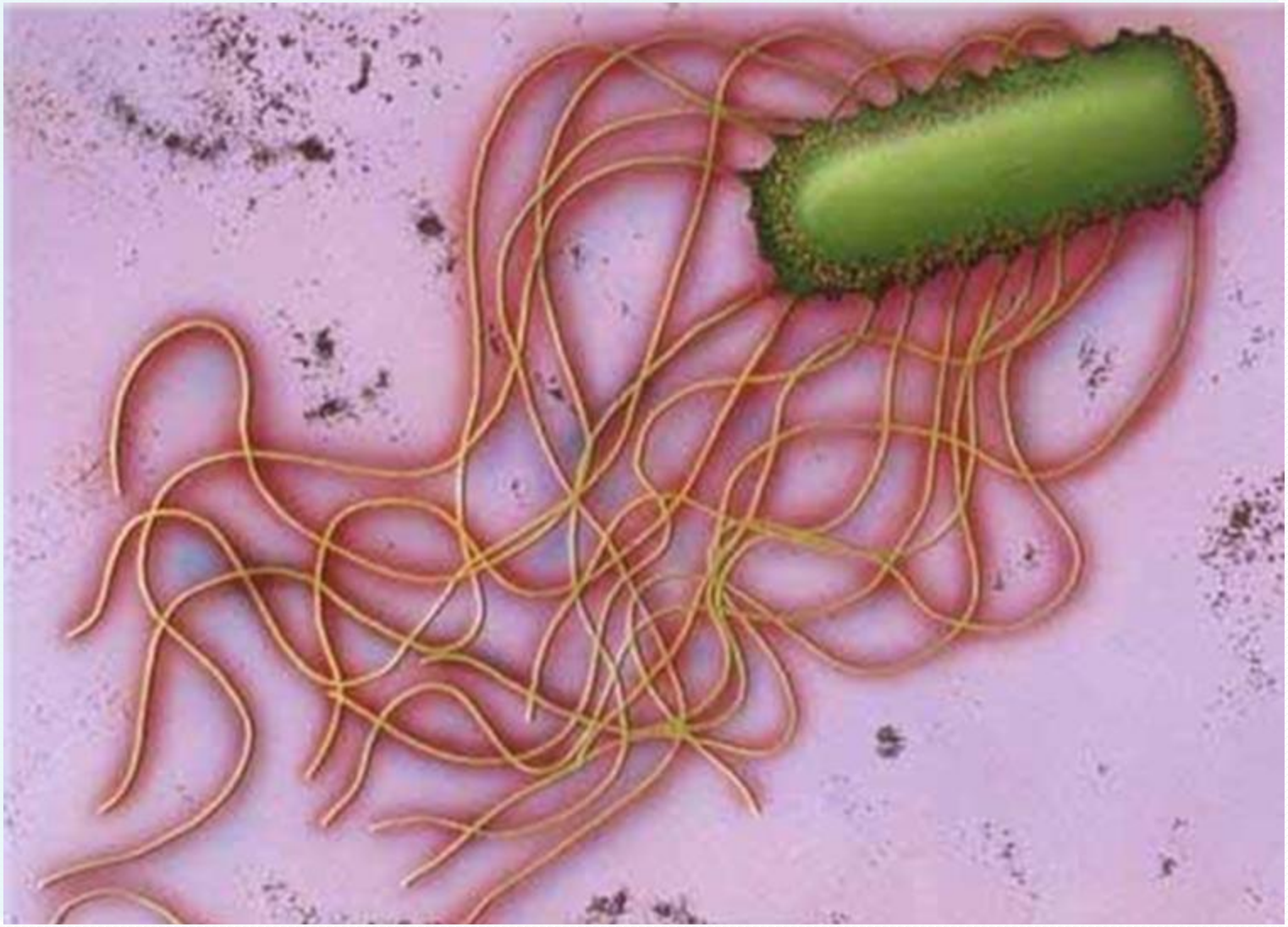


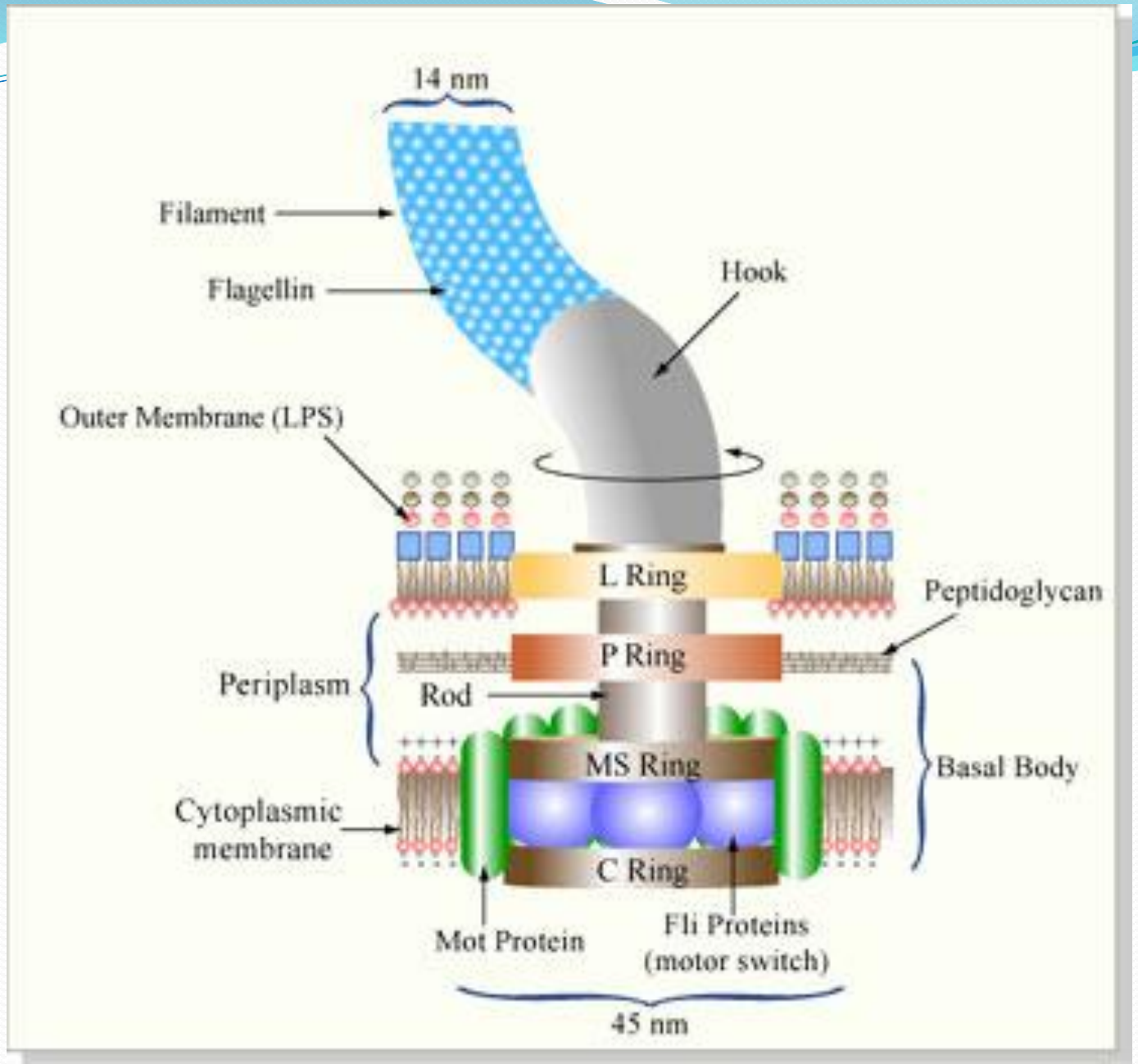


فلاژل



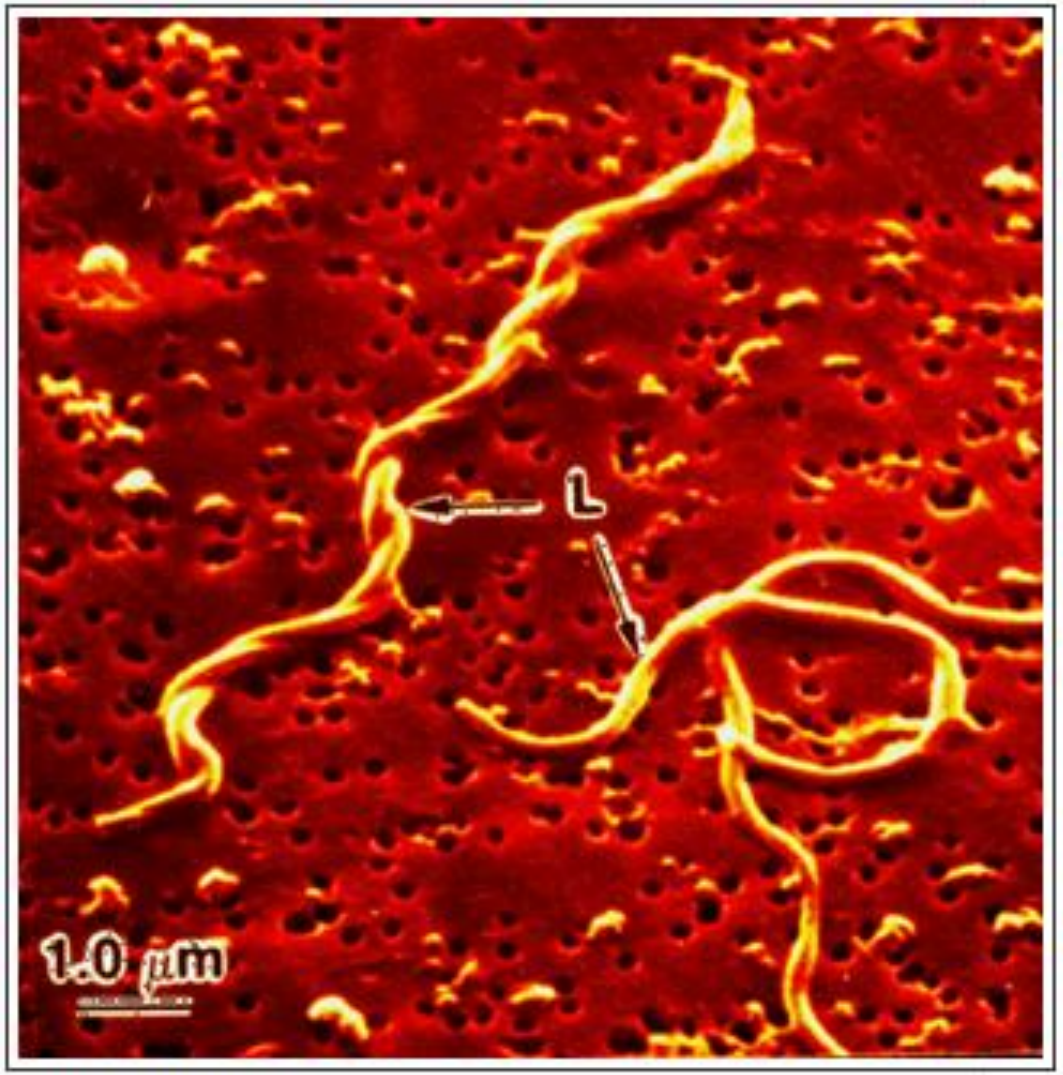





14 nm
Filament
Flagellin
Hook
Outer Membrane (LPS)
L Ring
Peptidoglycan
P Ring
Periplasm
Rod
MS Ring
Basal Body
Cytoplasmic membrane
C Ring
Mot Protein
Fli Proteins (motor switch)
45 nm

Borrelia burgdorferi is motile through the undulation of its axial filaments. It is transmitted to humans by the bite of infected ticks (*Ixodes scapularis* and *Ixodes pacificus*) and cause a serious progressive disease called lyme disease.

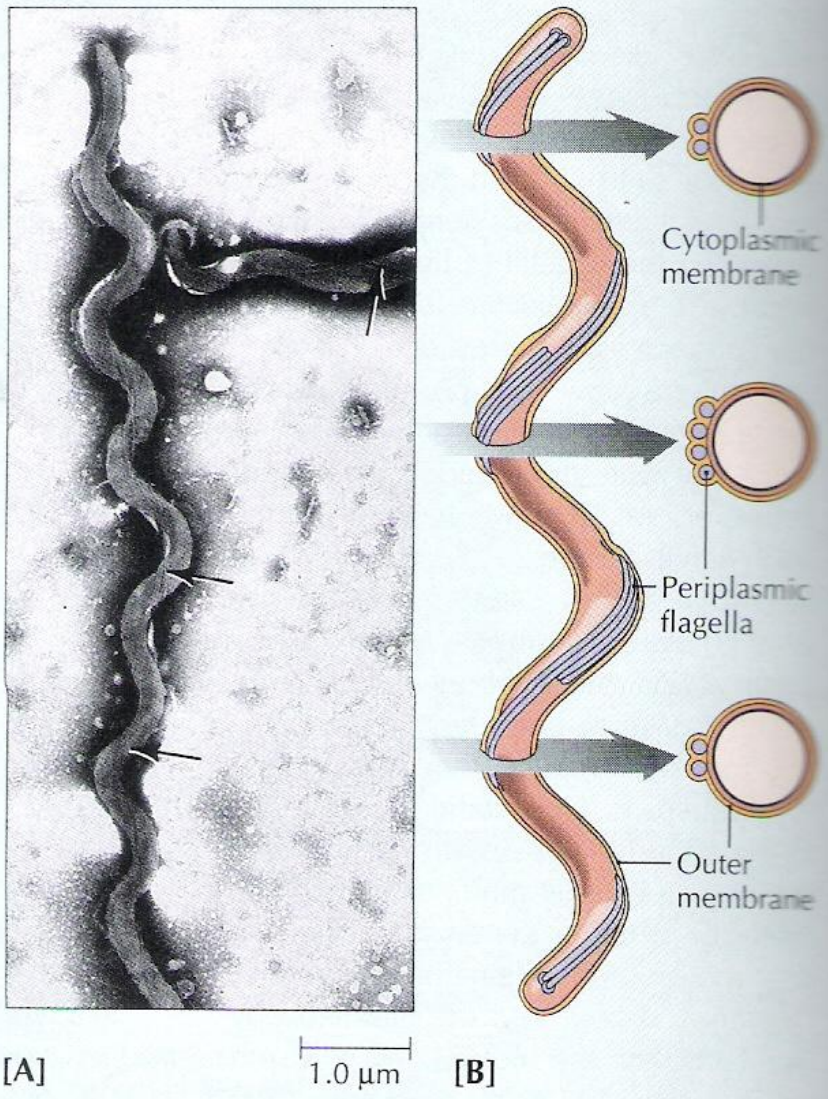
The story of lyme disease began in 1975 when a mother, with her children in lyme city in the United States, was admitted to a hospital with signs of rheumatoid arthritis. It was a mysterious case until the discovery of *Borrelia burgdorferi* and that is how the disease got its name, when it was discovered in 1982.

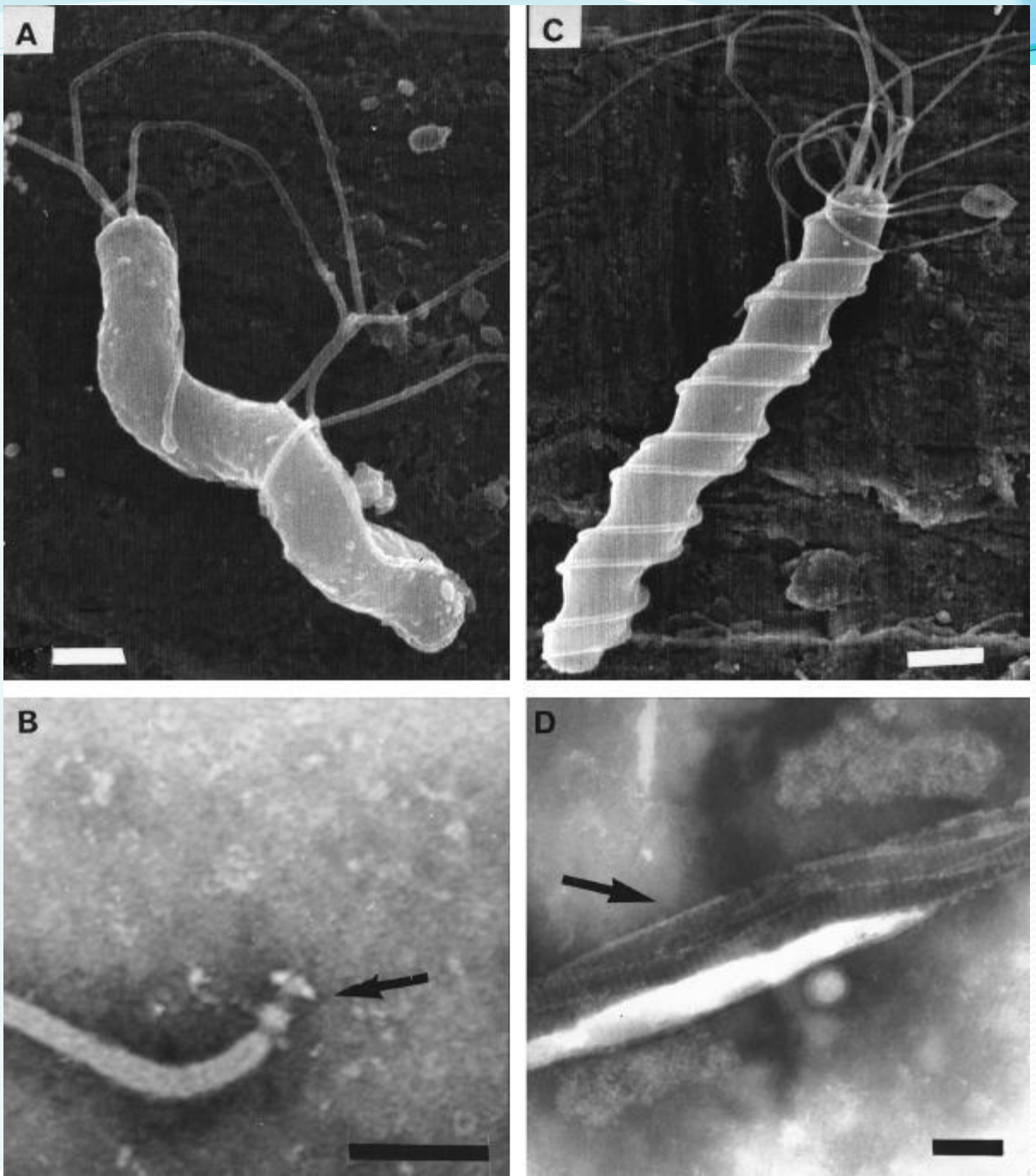


Borrelia burgdorferi

FIGURE 4.10

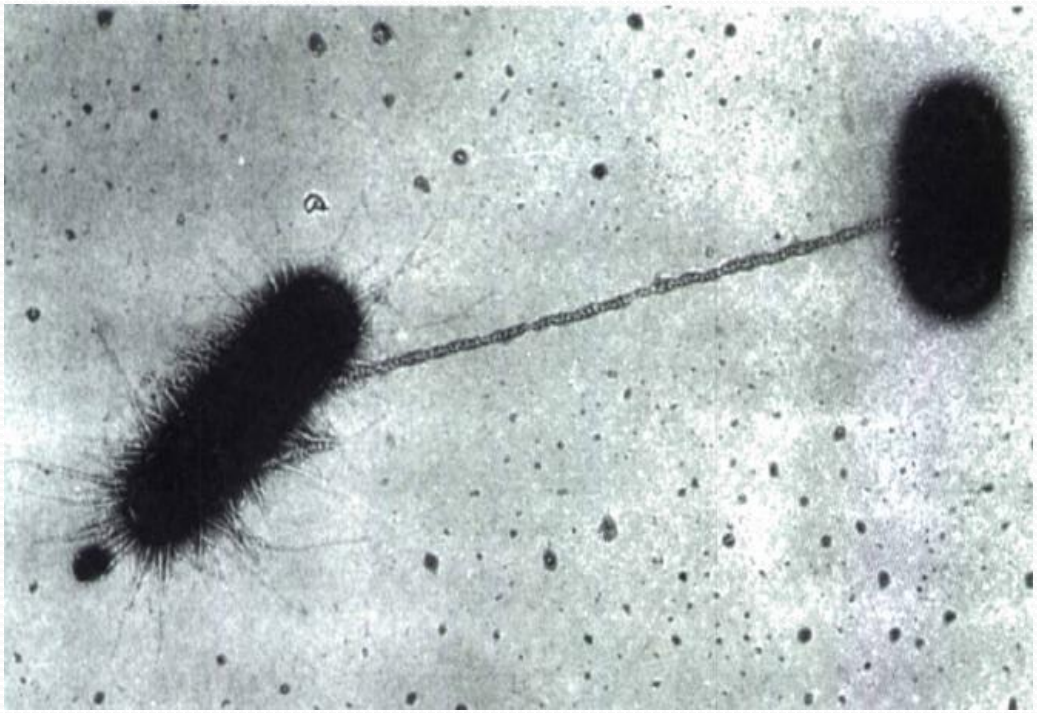
[A] *Treponema denticola*, a spirochete, exhibits periplasmic flagella beneath the outer membrane as indicated by the arrows. **[B]** Diagrammatic representation of a treponeme, showing three cross-sectional areas, enlarged to show details.



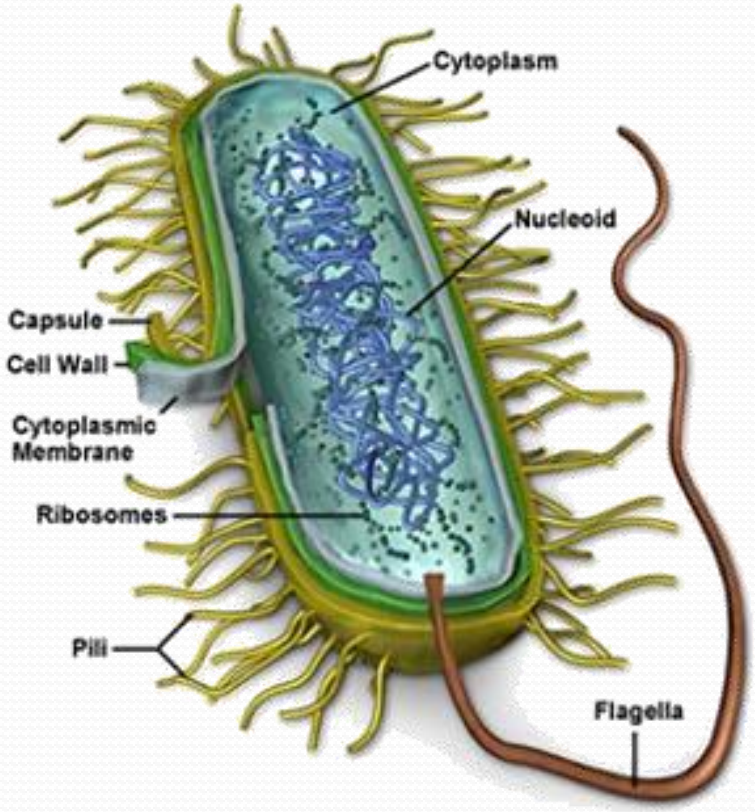

A
C
B
D

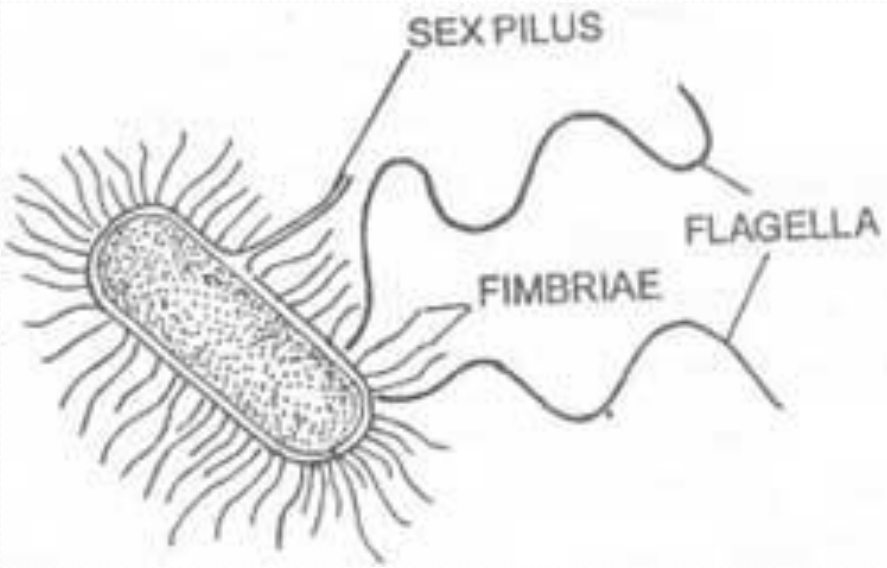
Pilus

- Adhesion
- Sex pilus

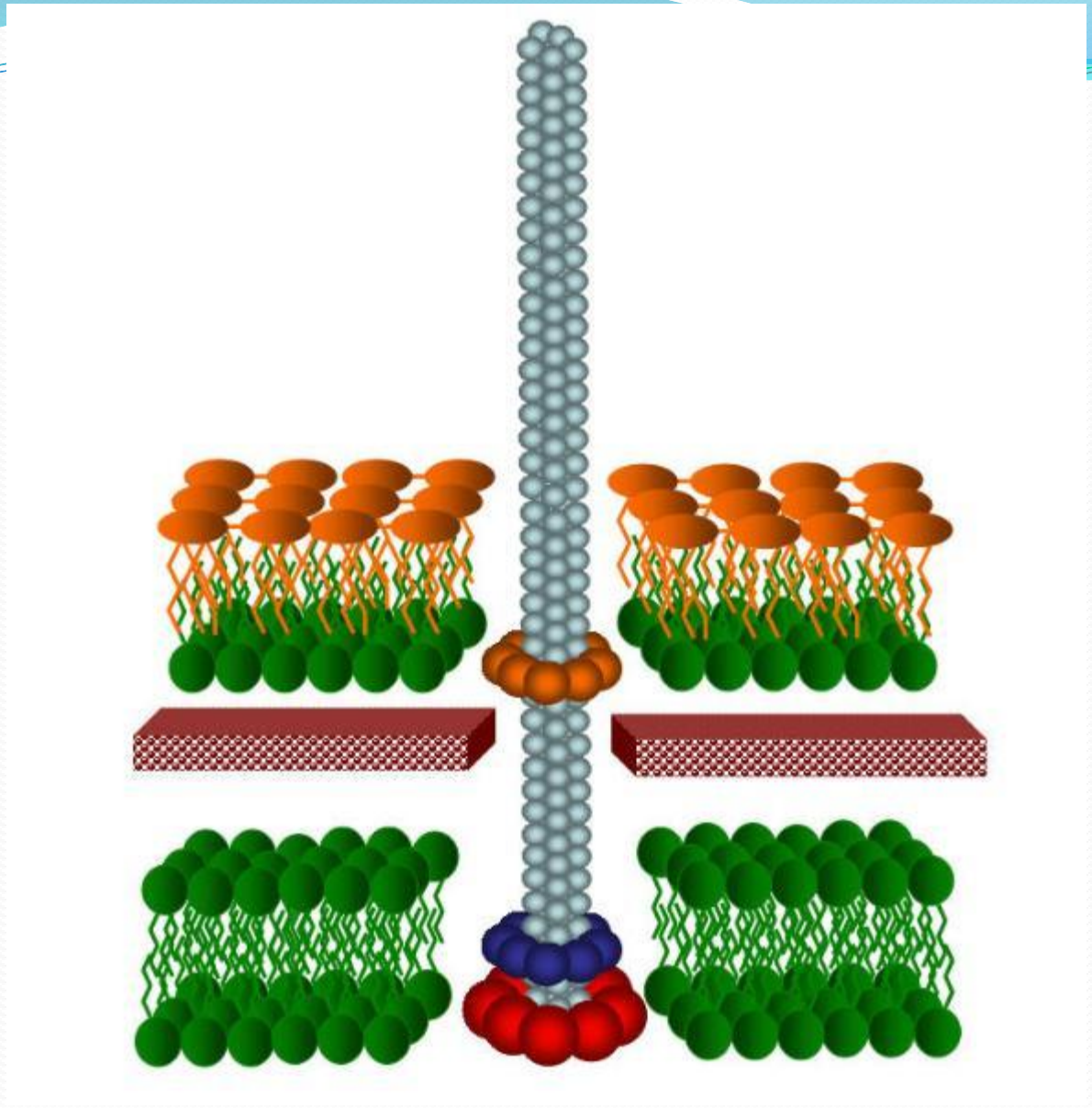


پیلی

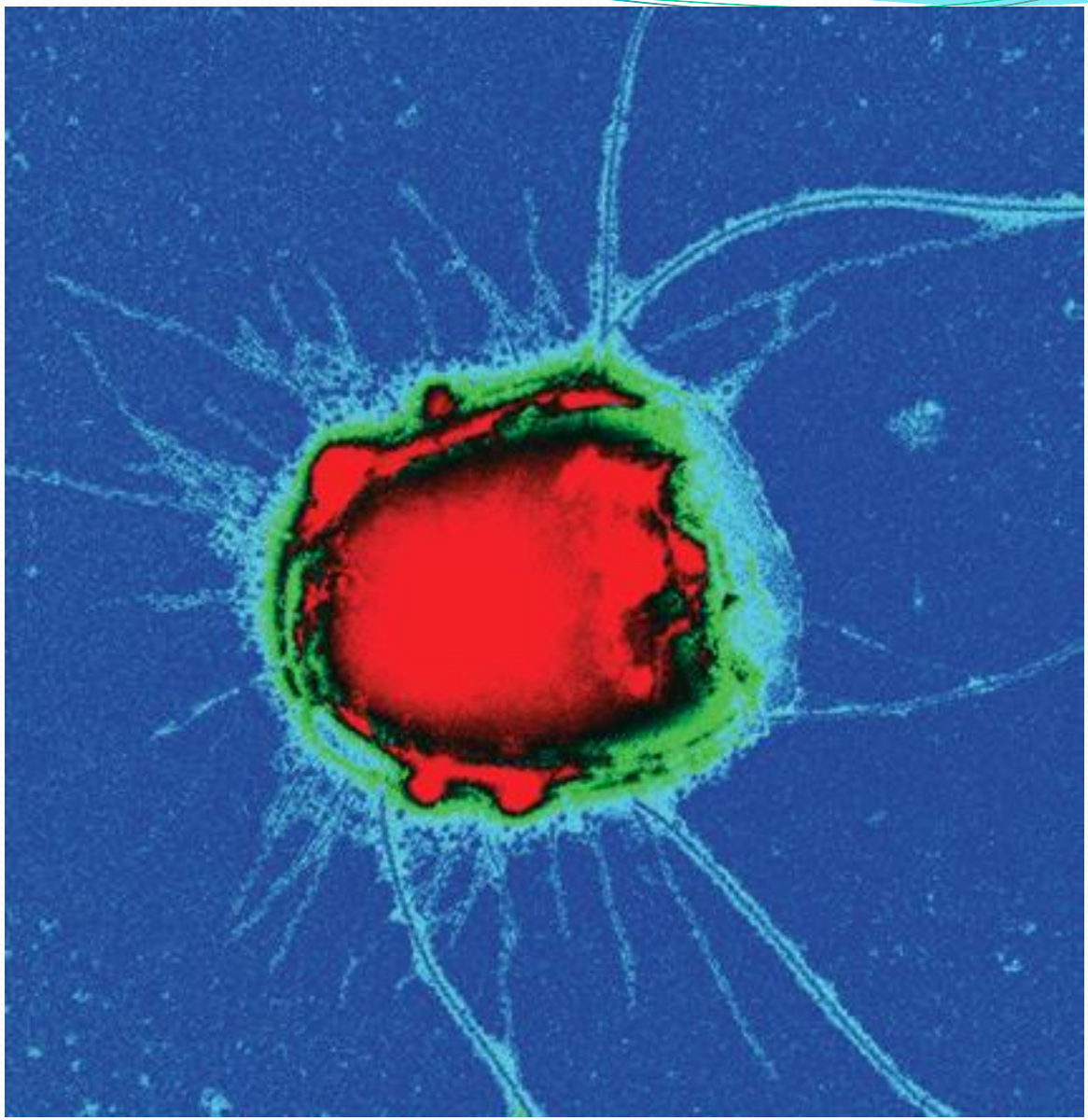


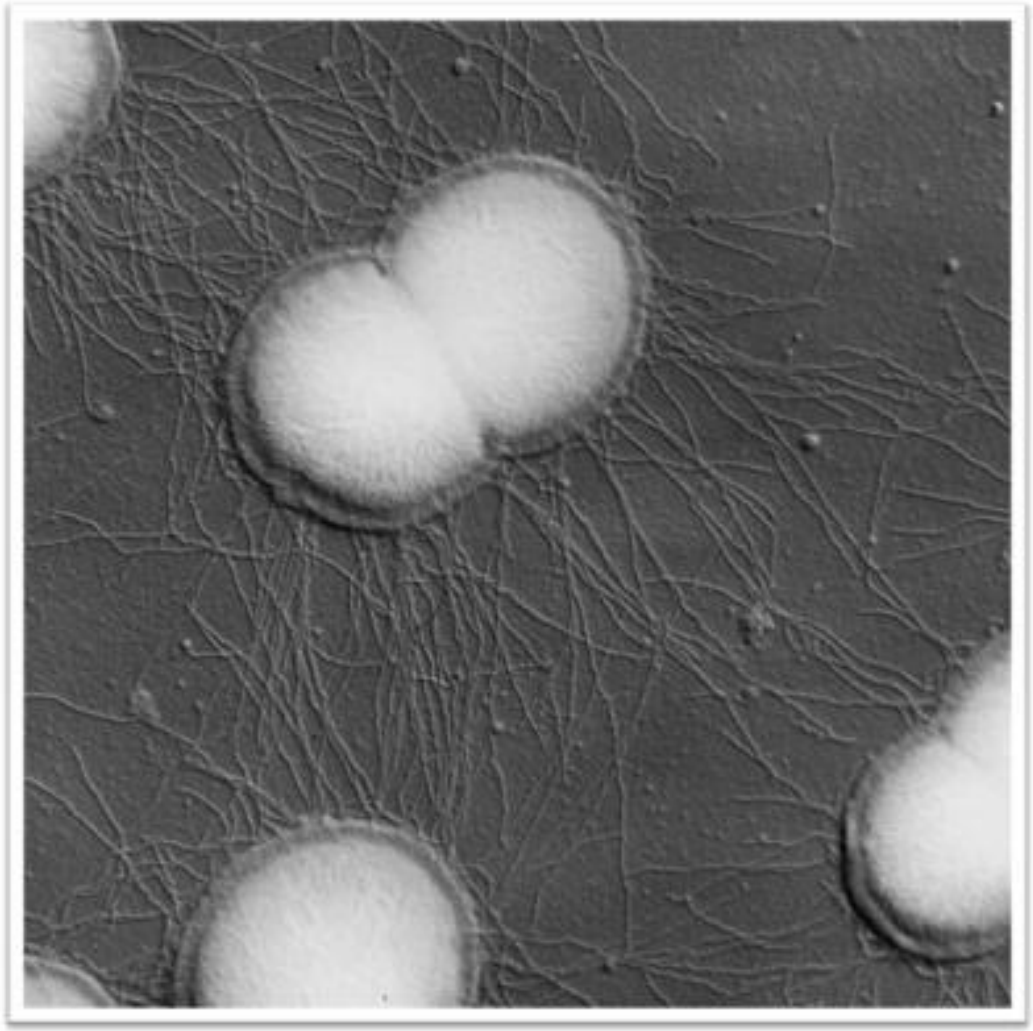


Pilli (Pilus)



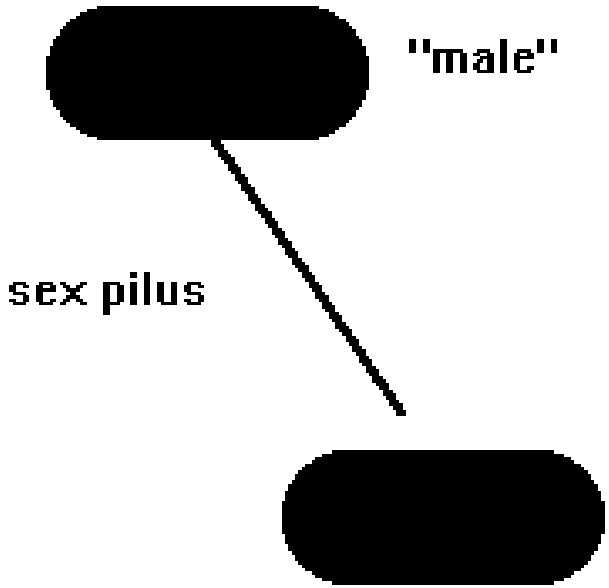
تصویر شماتیک یک پیلی در سطح باکتری گرم منفی

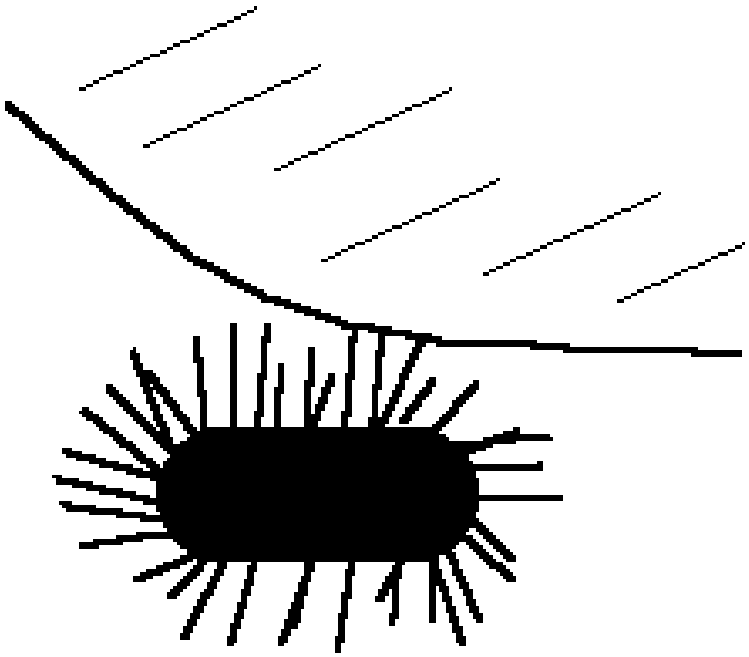




Scanning electron micrograph of *Neisseria gonorrhoeae* diplococci

Pili and Fimbriae

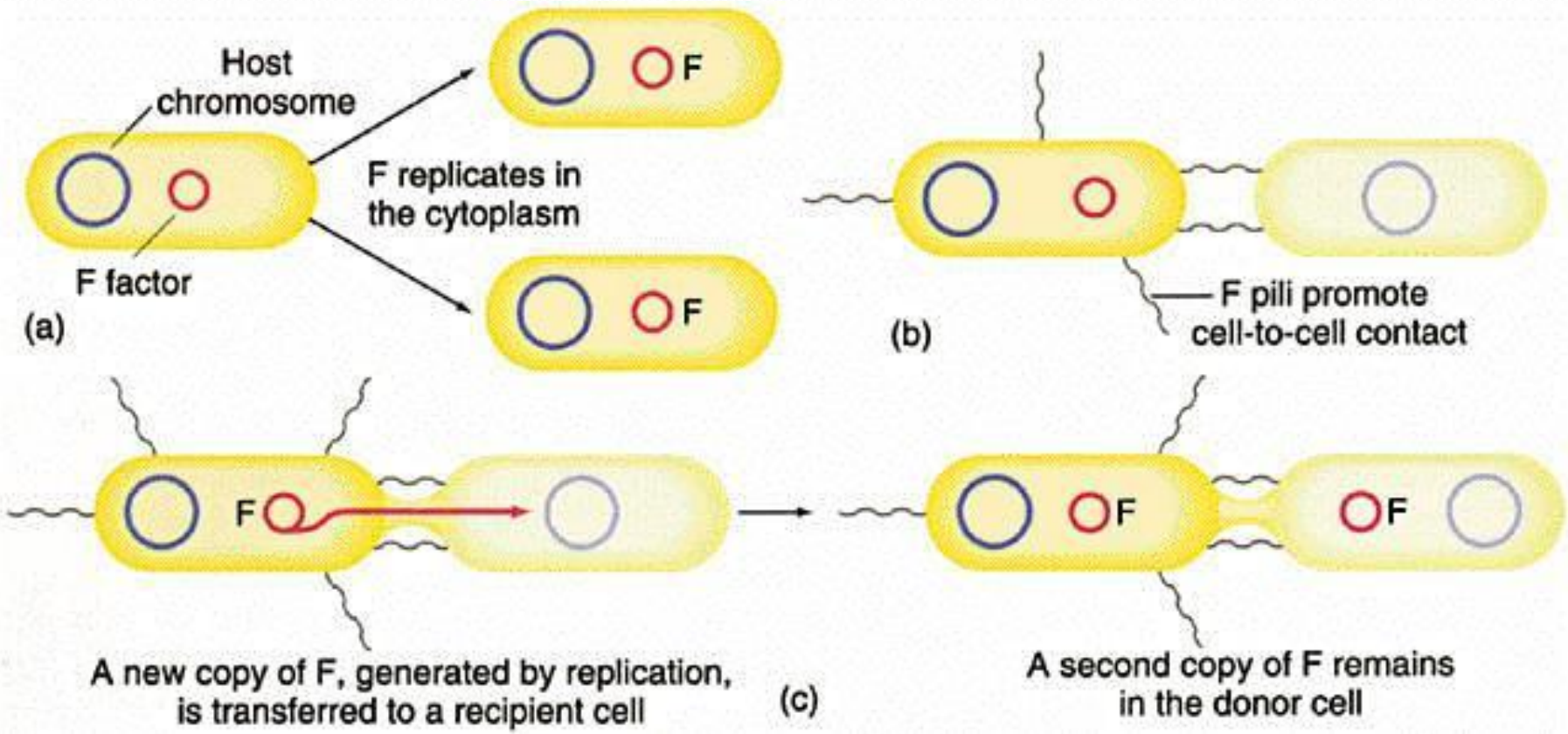


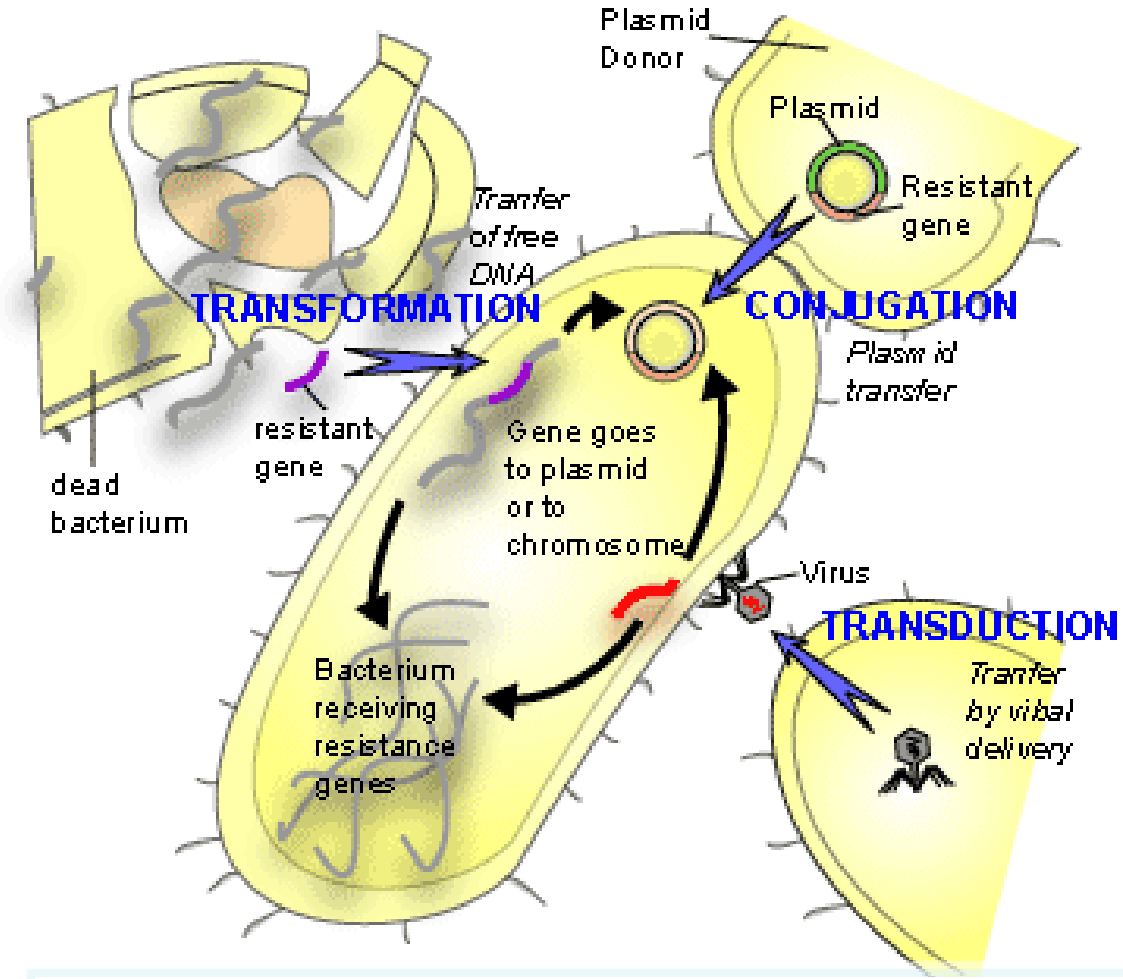


bacteria displaying fimbriae, attached to a surface

تعامل میزبان و باکتری در بیماری سوزاک

الحاق ژنتیکی

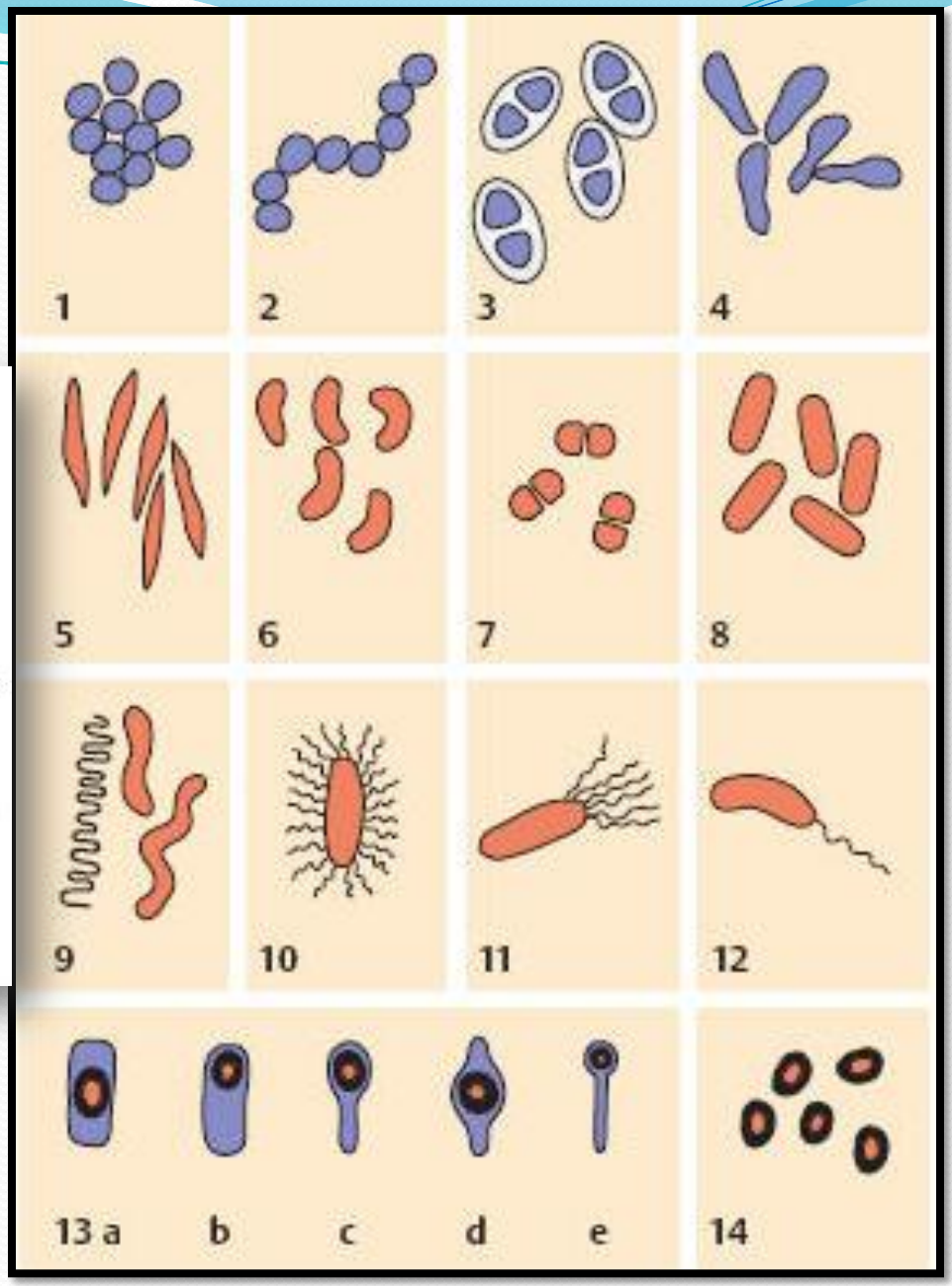




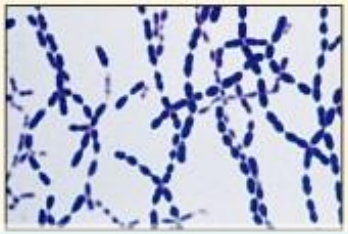
انتقال ژنتیکی در باکتری

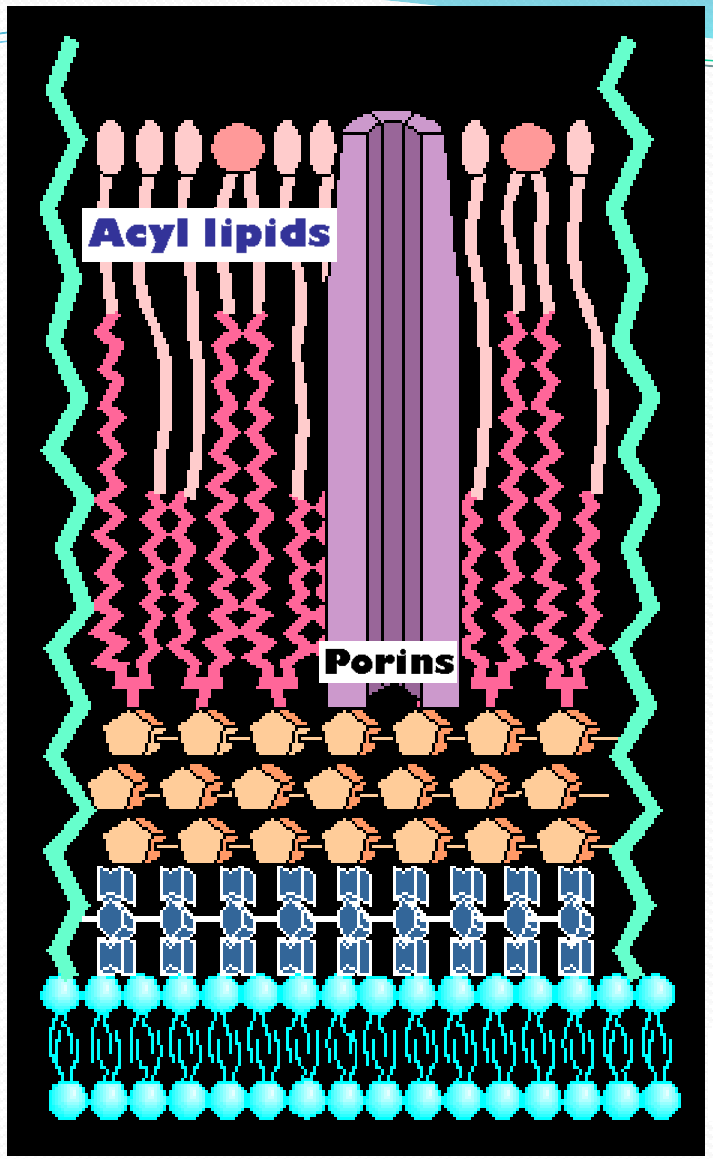
مورفولوژی باکتریها

1. Gram-positive cocci in grapelike clusters (staphylococci)
2. Gram-positive cocci in chains (streptococci)
3. Gram-positive cocci with capsules (pneumococci)
4. Gram-positive, clubshaped, pleomorphic rods (corynebacteria)
5. Gram-negative rods with pointed ends (fusobacteria)
6. Gram-negative curved rods (here commashaped vibrios)
7. Gram-negative diplococci, adjacent sides flattened (neisseria)
8. Gram-negative straight rods with rounded ends (coli bacteria)
9. Spiral rods (spirilla) and Gram-negative curved rods (*Helicobacter*)
10. Peritrichous flagellation
11. Lophotrichous flagellation
12. Monotrichous flagellation
13. Formation of endospores (sporulation) in cells of the genera *Bacillus* and *Clostridium* (spore stain)
    a) Central spore, vegetative cell shows no swelling
    b) Terminal spore, vegetative cell shows no swelling
    c) Terminal spore ("tennis racquet")
    d) Central spore, vegetative cell shows swelling
    e) Terminal spore ("drumstick")
14. Free spores (spore stain)



Some Comparative Characteristics of Gram-Positive and Gram-Negative Bacteria

Characteristic	Gram-Positive	Gram-Negative
		
Gram reaction	Retain crystal violet dye and stain dark violet or purple	Can be decolorized to accept counterstain (safranin) and stain red
Peptidoglycan layer	Thick (multilayered)	Thin (single-layered)
Teichoic acids	Present in many	Absent
Periplasmic space	Absent	Present
Outer membrane	Absent	Present
Lipopolysaccharide (LPS) content	Virtually none	High
Lipid and lipoprotein content	Low (acid-fast bacteria have lipids linked to peptidoglycan)	High (due to presence of outer membrane)
Flagellar structure	2 rings in basal body	4 rings in basal body
Toxins produced	Primarily exotoxins	Primarily endotoxins
Resistance to physical disruption	High	Low
Cell wall disruption by lysozyme	High	Low (requires pretreatment to destabilize outer membrane)
Susceptibility to penicillin and sulfonamide	High	Low
Susceptibility to streptomycin, chloramphenicol, and tetracycline	Low	High
Inhibition by basic dyes	High	Low
Susceptibility to anionic detergents	High	Low
Resistance to sodium azide	High	Low
Resistance to drying	High	Low



Lipoarabinomannon (LAM)

Acyl Lipids

Mycolic Acids

Arabinogalactan

Peptidoglycan

Lipid bilayer

دیواره سلولی مایکوباکتریومها