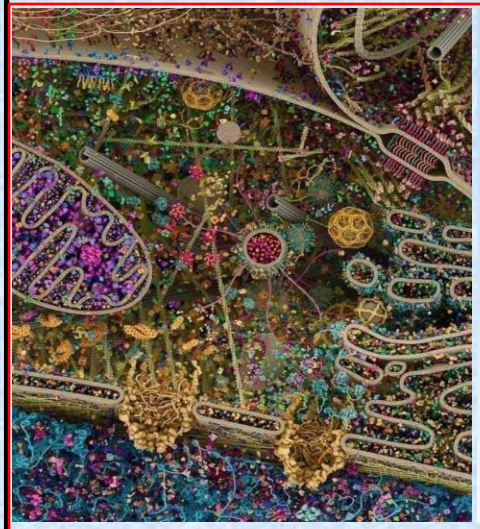
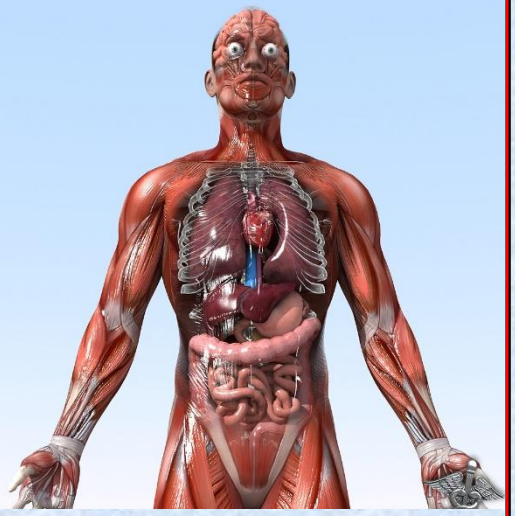
General Animal Biology

Zoo-109 | علم الأحياء | **109- حـيـن**





For Pre-Medical Students | **Common First Year**

السنة الأولى المشتركة - المسار الصحي

1447-H - 2026

Reference: *Campbell, N. A. and Reece, J. B. (2014). Biology (10th edition). Pearson Education. Inc. USA.*

عمادة التعليم الإلكتروني والتعلم عن بعد
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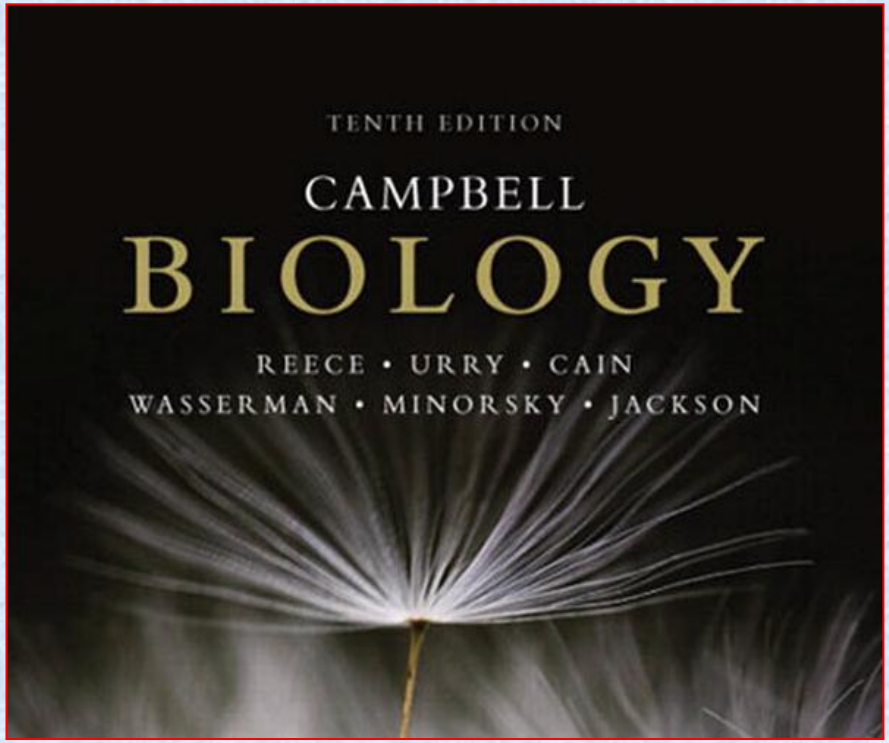
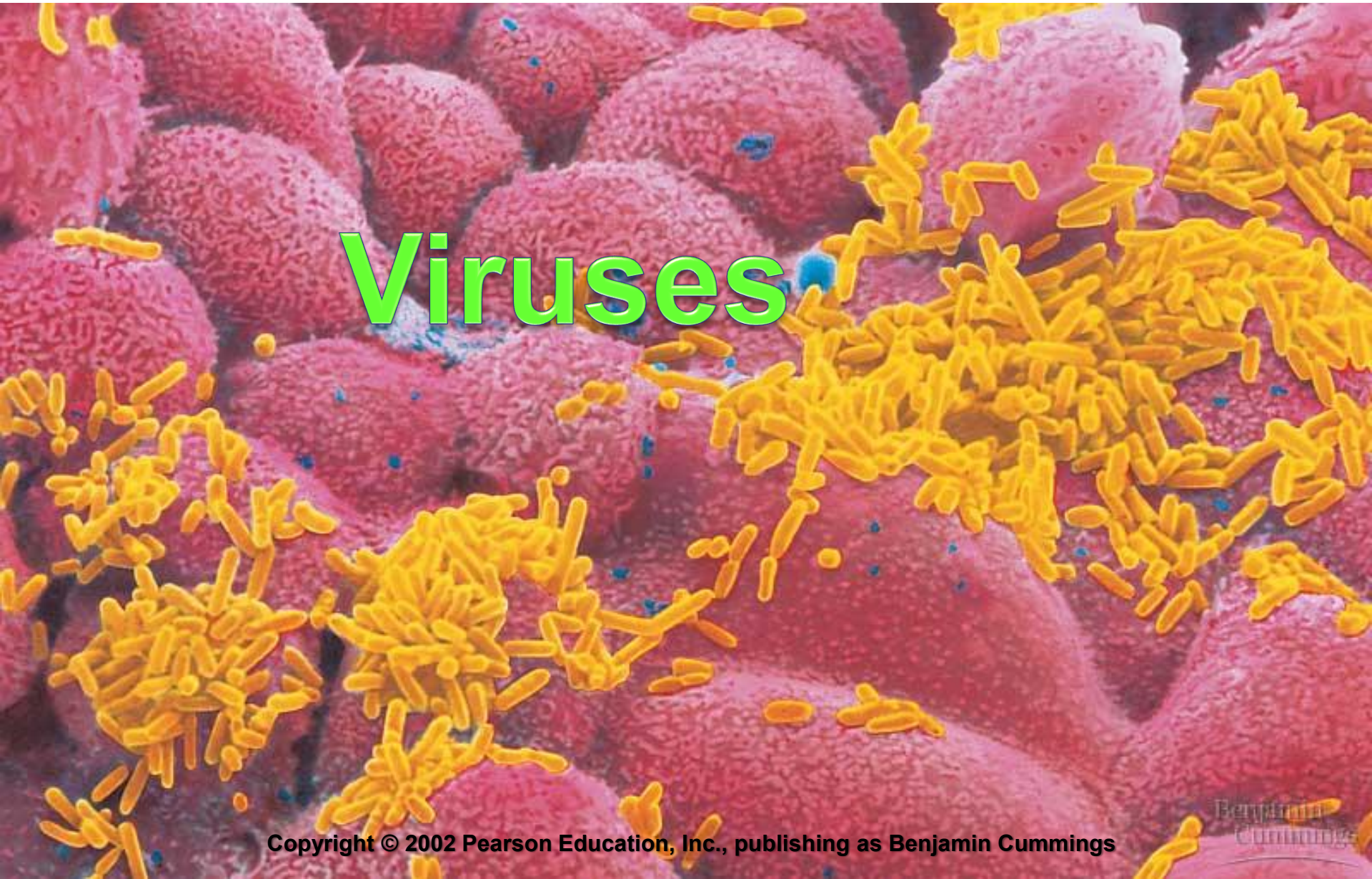
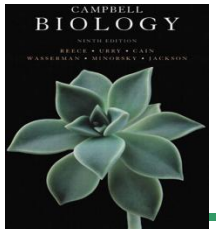
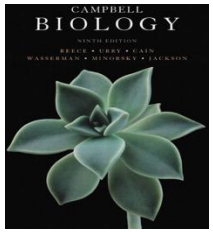






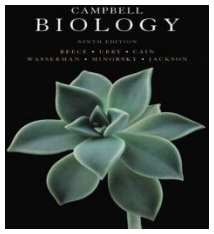
Objectives

- Describe why viruses are not considered as living organisms.
- Describe the basic structure of viruses.
  - A virus consists of a nucleic acid surrounded by a protein coat.
    - *Viral Genomes.*
    - *Capsids and Envelopes.*
- Viruses replicate only in host cells.
- Replicative Cycles of Phages.
  - *The Lytic Cycle.*
  - *The Lysogenic Cycle.*
- Compare between the lytic and lysogenic cycles of virus replication.

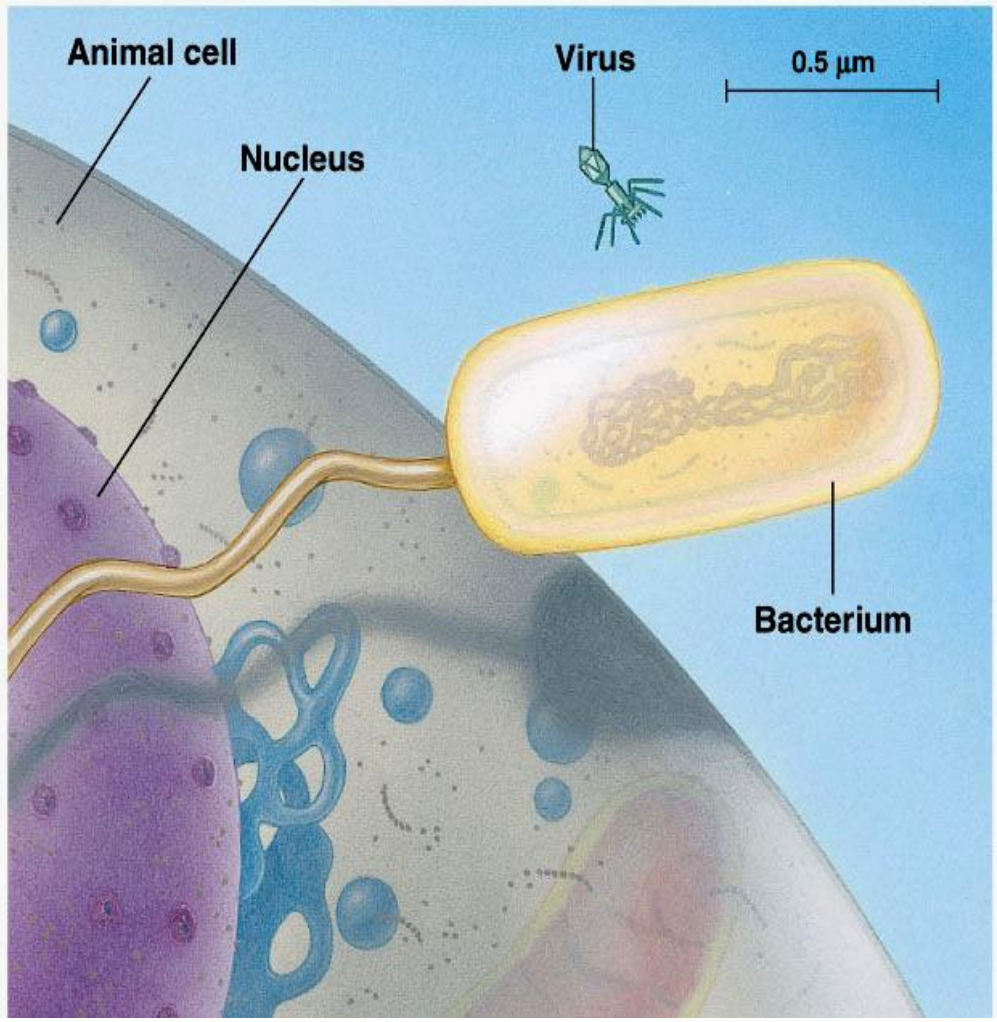


What are viruses?

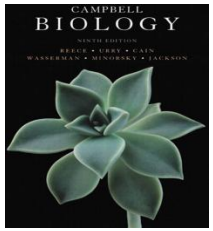
- At the boundary of life, between the macromolecules (which are not alive) and the prokaryotic cells (which are alive), lie the viruses and bacteriophages (phages).
- These creatures are parasites responsible for causing many diseases in living things (HIV in humans, as an example).
- Viruses are found everywhere.
- Viruses consist of a core of nucleic acid, either DNA or RNA, and a protective coat of protein.
- Viruses do not show any of the expected signs of life.
- Viruses:
  - do not respond to stimuli,
  - do not grow,
  - do not do any of the things we normally associate with life.
- Viruses are not considered "living" organisms. However, they do show one of the most important signs of life (the ability to reproduce in a host cell).



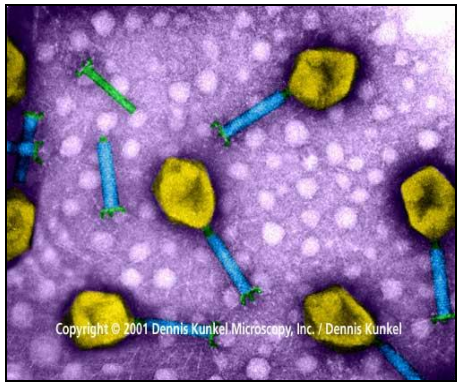
What are viruses?

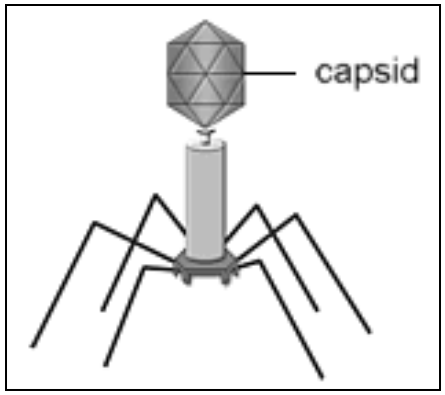


- Viruses are much smaller than bacteria.
- Virus is about 20nm in diameter.
- Viruses are not cells.
- A virus is a genome حامض نووي enclosed in a protective coat غطاء واقي



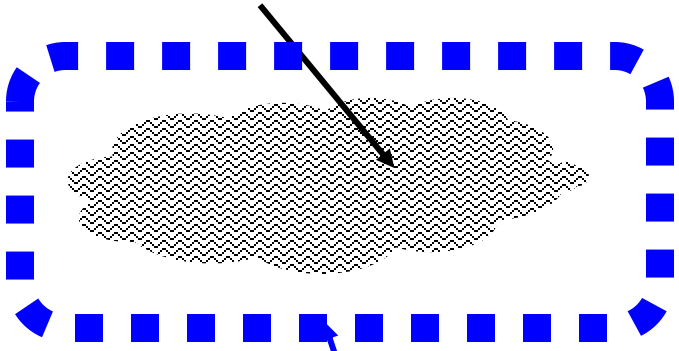
Virus is a genome enclosed in a protective coat



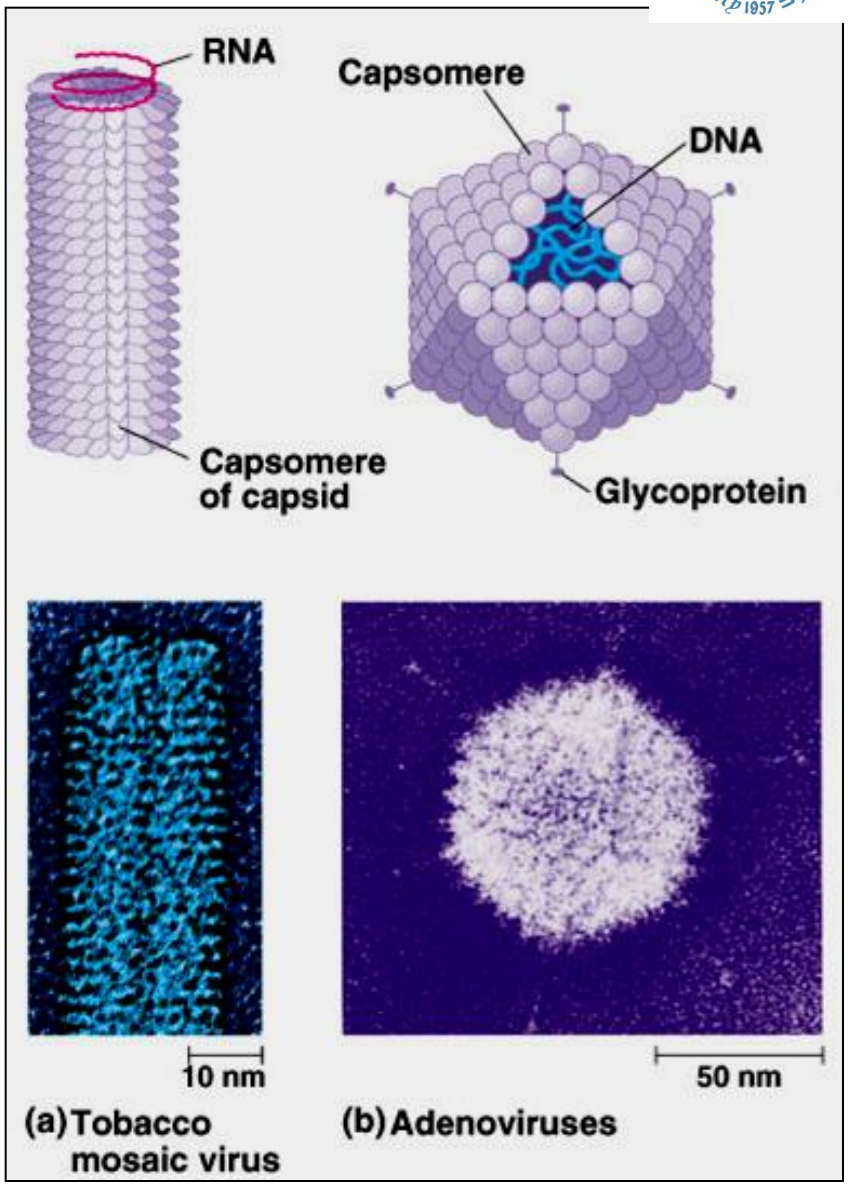


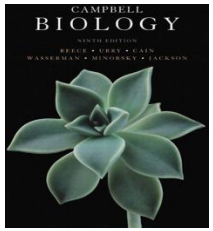
bacteriophages

Genome (DNA/RNA)



Protein coat (capsid)

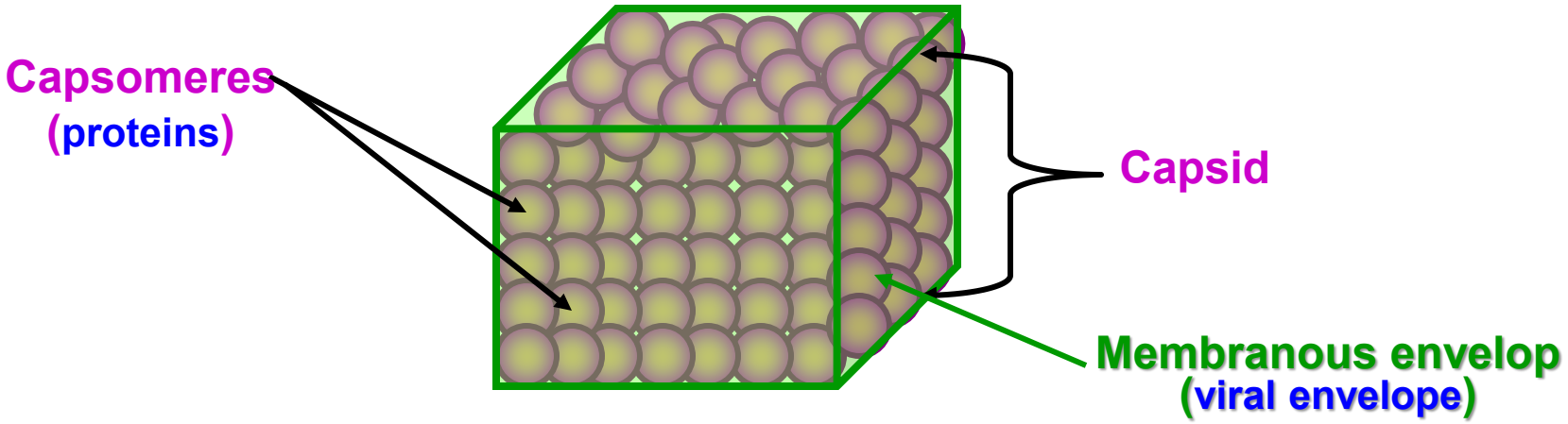




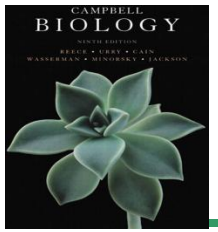
Viral Capsid and Envelope

A- Capsid الغلاف الفيروسي

- A protein shell that encloses the viral genome.
- It is rode-shaped, helical, polyhedral or more complex.
- Capsomeres: Are the protein units that form capsid.

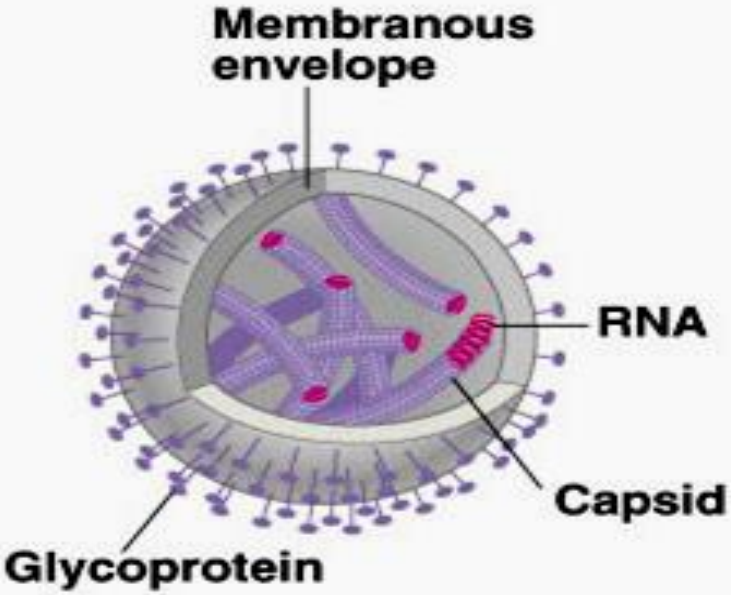


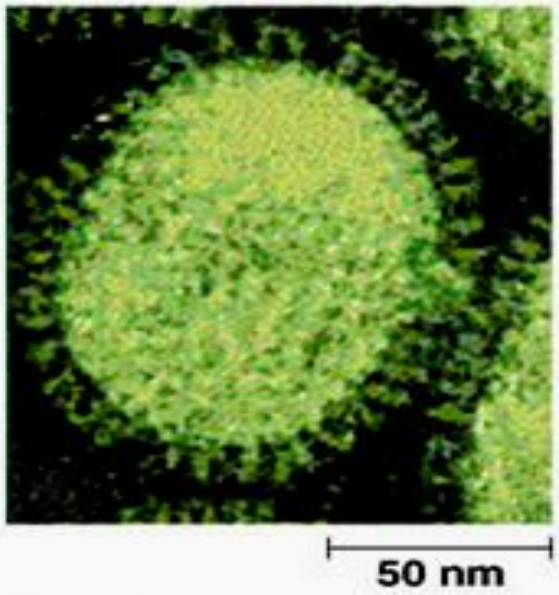
Sometimes further wrapped يُغَلَّف in a membranous envelope (Viral envelope الغطاء الفيروسي), eg. Influenza virus.



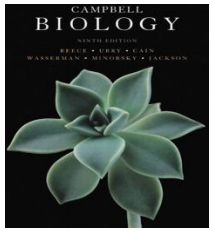
B- Envelope الغطاء الفيروسي

- Some viruses have viral envelopes, membranes cloaking their capsids.
- These envelopes are derived from the membrane of the host cell.





(c) Influenza viruses



Types of Viral Genome:
(Hereditary material المادة الوراثية)

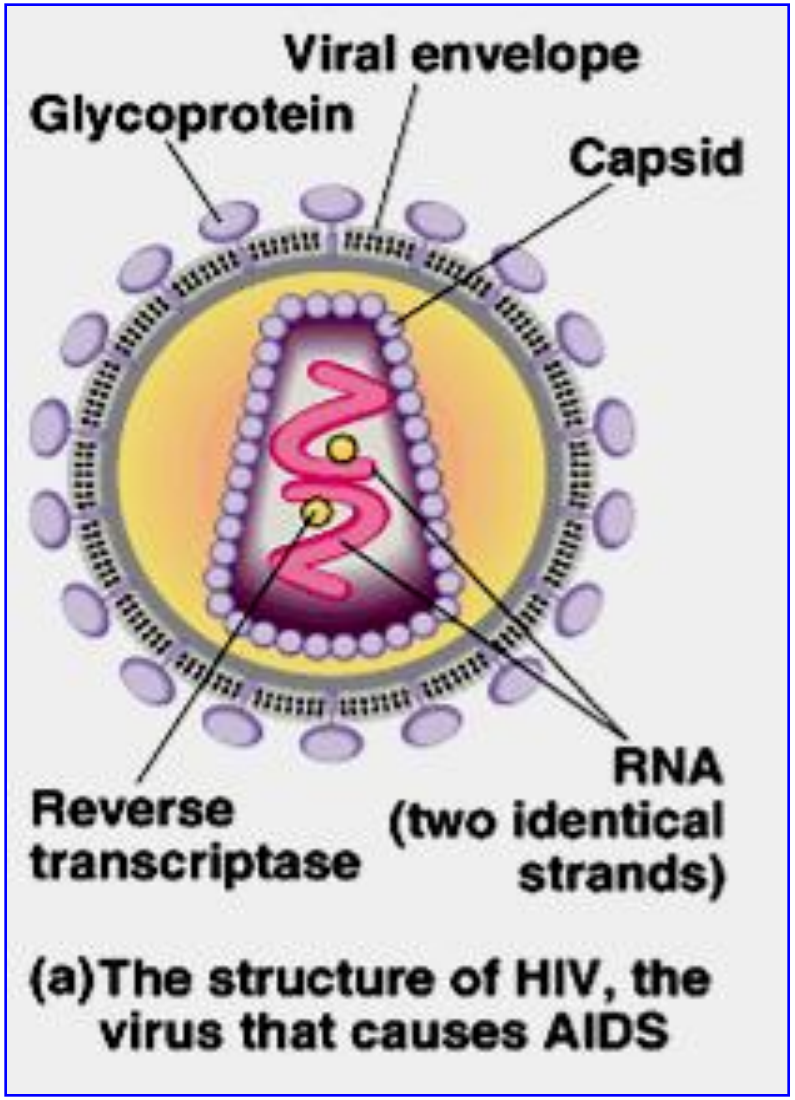
Viral genomes may consist of:

- double-stranded DNA (dsDNA),
- single-stranded DNA (ssDNA),
- double-stranded RNA (dsRNA),
- single-stranded RNA (ssRNA).

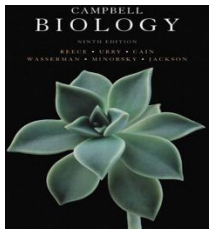
depending on the specific type of the virus.

The viral genome is usually organized as a single linear or circular molecule of nucleic acid.

The smallest viruses have only four genes, while the largest have several hundred.



(a) The structure of HIV, the virus that causes AIDS



Virus-Reproduction within a living host cell

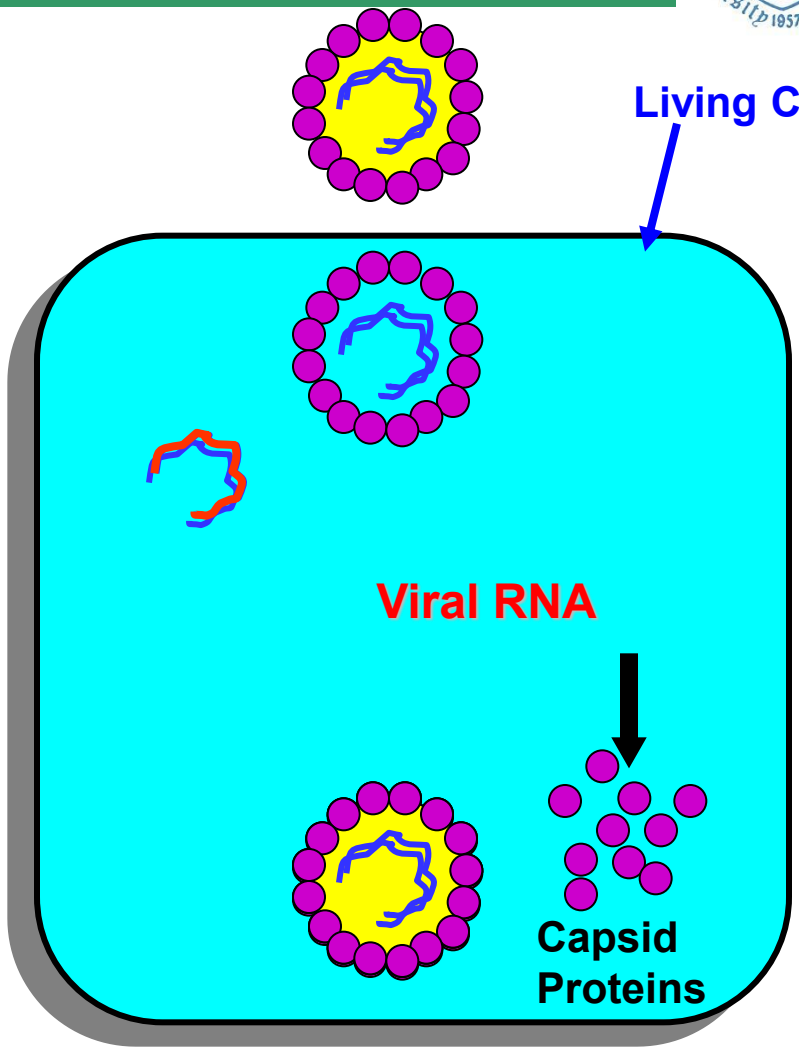
Obligate parasitism التطفل الإجباري

1-Inters the cell and releases its genome

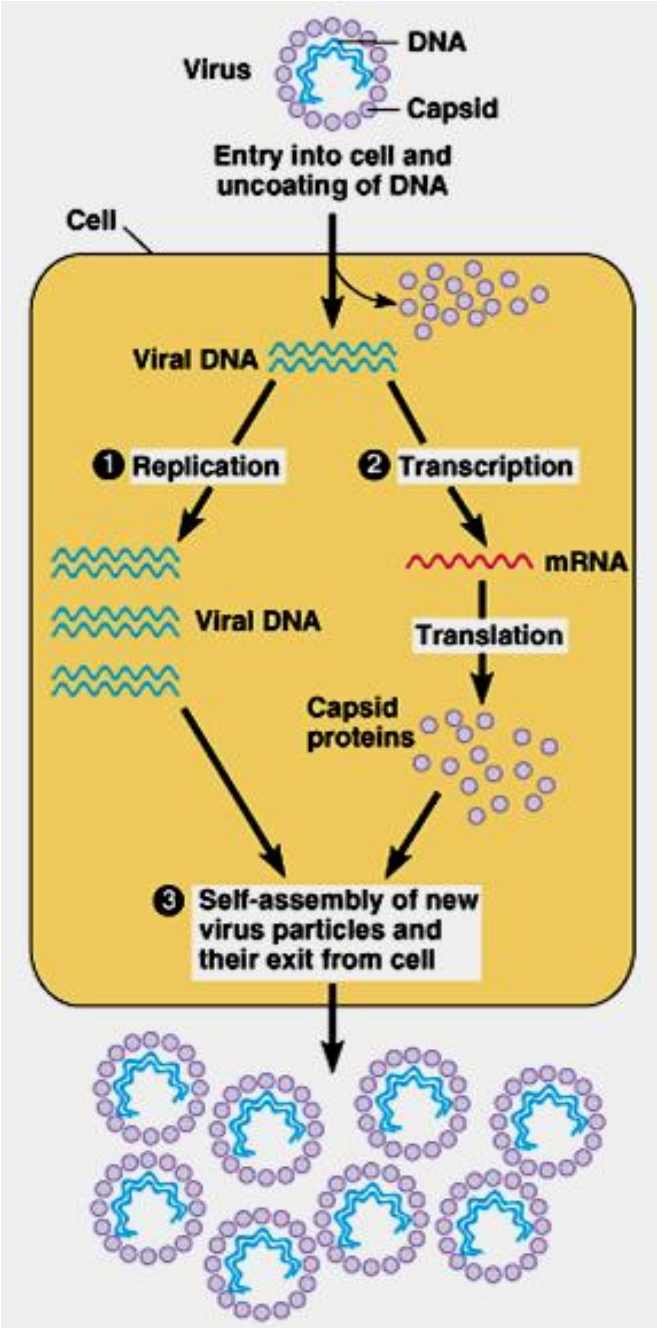
2- Replicates using host nucleotides and enzymes

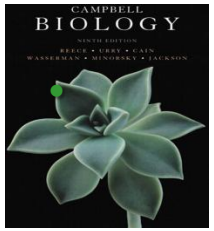
3- Produce a new capsid units using host cell resources.

4- The new viral DNA and proteins assemble to form new viruses



- **A viral infection begins when the genome of the virus enters the host cell.**
- **Once inside, the viral genome commandeers its host, reprogramming the cell to copy viral nucleic acid and manufacture proteins.**
- **The nucleic acid molecules and capsomeres then self-assemble into viral particles and exit the cell.**

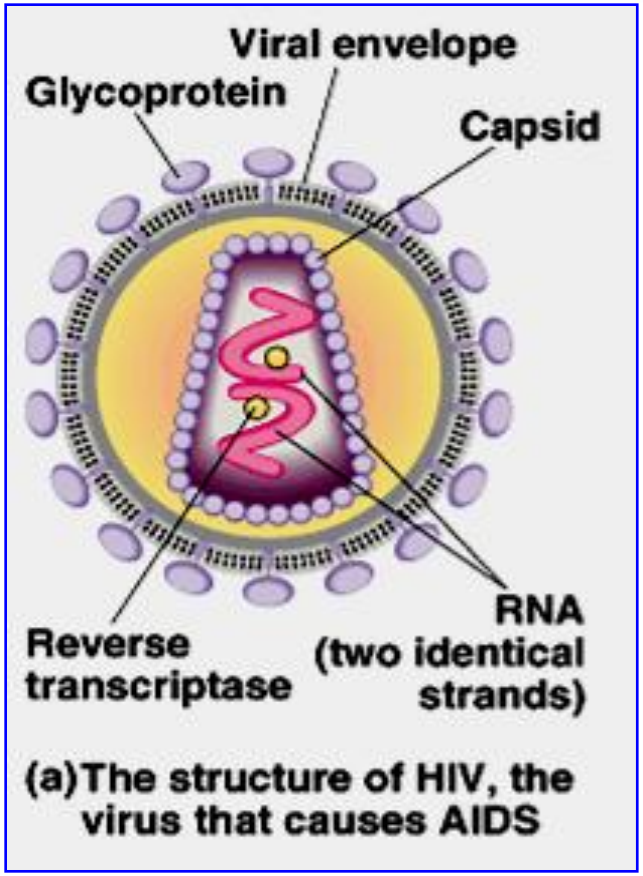




Human Immunodeficiency Virus (HIV), the virus that causes AIDS (Acquired Immuno-Deficiency Syndrome) is a retrovirus.

The retrovirus

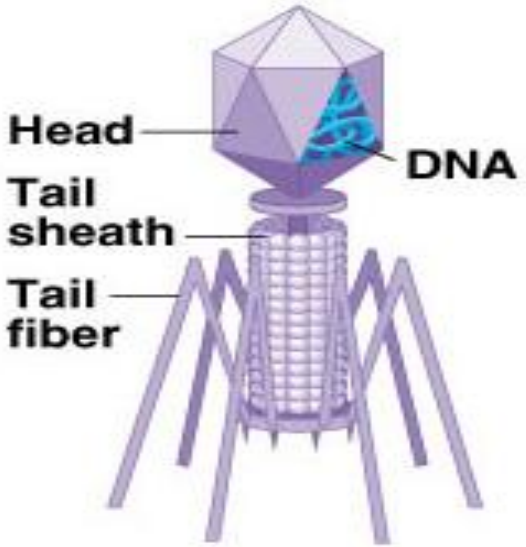
- A retrovirus is an RNA virus that is duplicated in a host cell using the reverse transcriptase enzymes to produce DNA from its RNA genome. The DNA is then incorporated into the host's genome by an integrase enzymes.



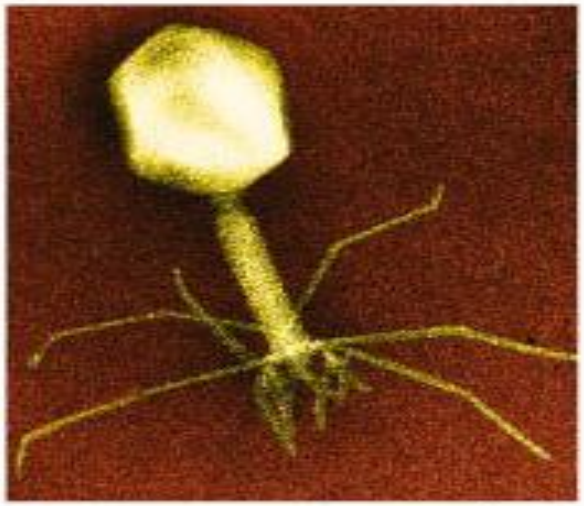
- This viral particle includes:
  - ✓ An envelope with glycoproteins,
  - ✓ A capsid containing two identical RNA strands as its genome
  - ✓ Two copies of reverse transcriptase.
- An example is the AIDS (HIV) virus.

Bacteria infecting Viruses (bacteriophages)

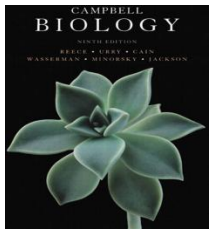
Bacteriophages (صواعق البكتريا)



- Viruses that infect bacteria, are called bacteriophages or (phages).
- It has a 20-sided capsid-head that encloses their DNA and protein tail piece that attaches the phage to the host and injects the phage DNA inside.
- Phages reproduce by Lytic Cycle (دورة مميتـــة) and/or Lysogenic cycle (دورة غير مميتة).



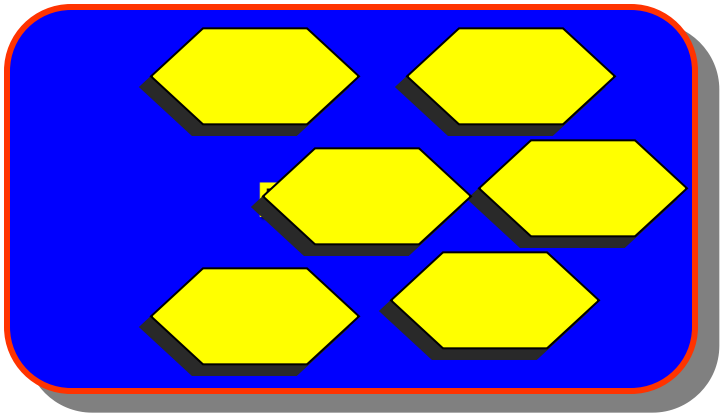
(d) Bacteriophage T4



Bacteriophages (*on E. coli*)

Phages reproductive cycles within bacteria (e.g: *Escherichia coli*)

Virus

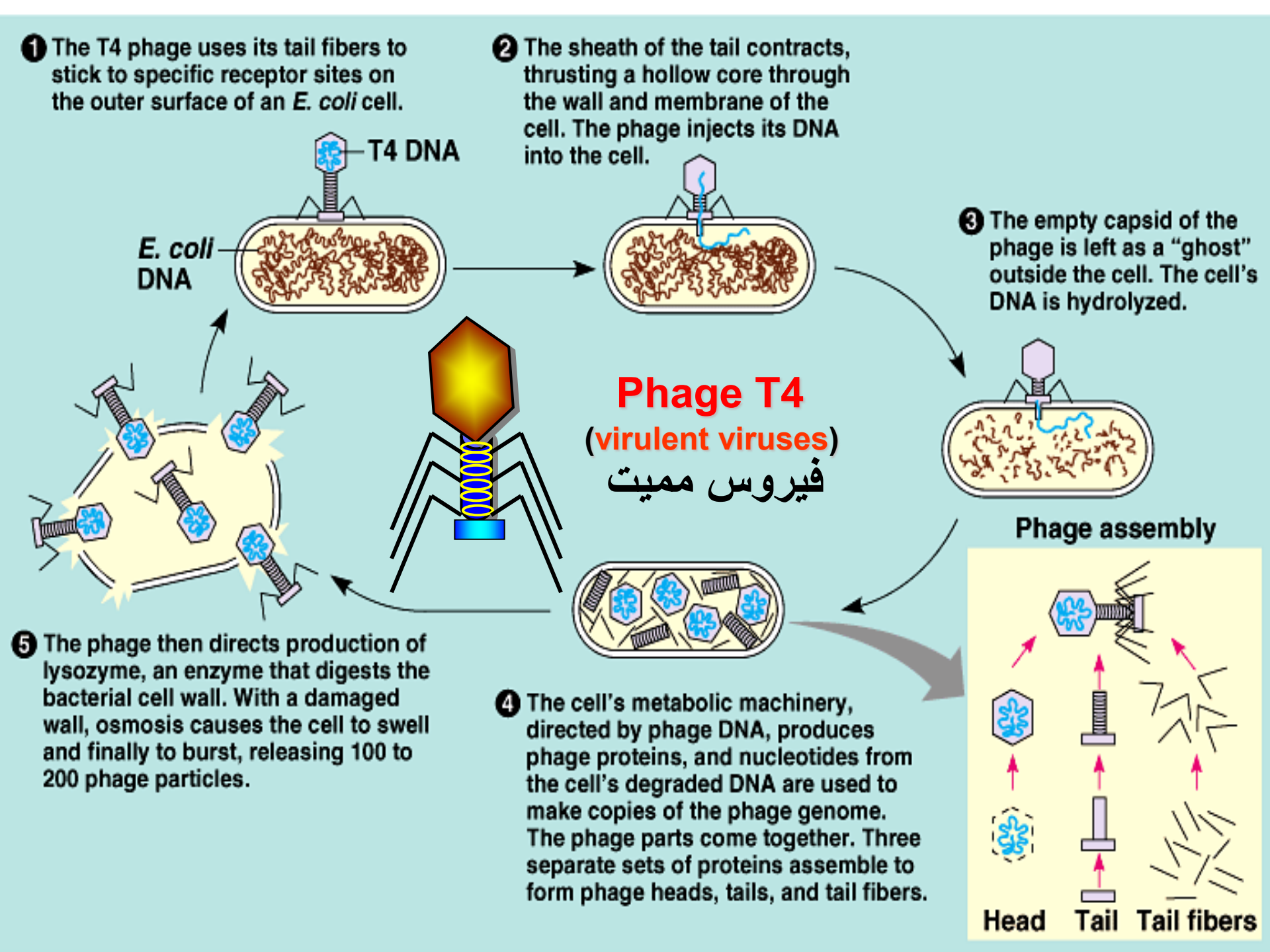


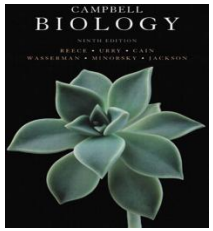
1)- lytic cycle (الدورة التحللية) ,

The phage reproductive cycle results in the death of the host.

- In the last stage, the bacterium lyses (breaks open) and releases the phages produced within the cell to infect others.

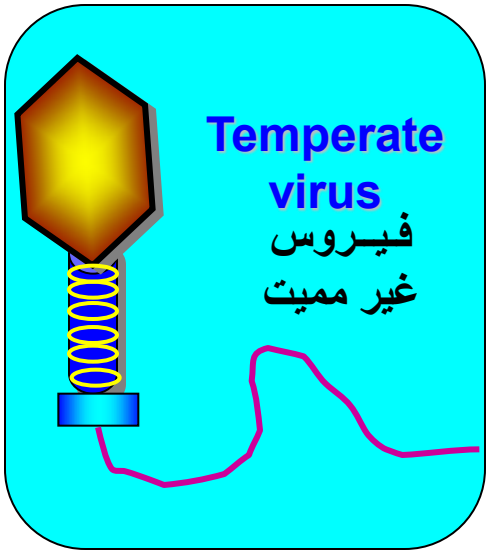
- **Virulent phages** فيروسات قاتلة **reproduce only by a lytic cycle.**


1 The T4 phage uses its tail fibers to stick to specific receptor sites on the outer surface of an E. coli cell.
T4 DNA
E. coli DNA
2 The sheath of the tail contracts, thrusting a hollow core through the wall and membrane of the cell. The phage injects its DNA into the cell.
3 The empty capsid of the phage is left as a "ghost" outside the cell. The cell's DNA is hydrolyzed.
Phage T4
(virulent viruses)
فيروس مميت
Phage assembly
Head
Tail
Tail fibers
4 The cell's metabolic machinery, directed by phage DNA, produces phage proteins, and nucleotides from the cell's degraded DNA are used to make copies of the phage genome. The phage parts come together. Three separate sets of proteins assemble to form phage heads, tails, and tail fibers.
5 The phage then directs production of lysozyme, an enzyme that digests the bacterial cell wall. With a damaged wall, osmosis causes the cell to swell and finally to burst, releasing 100 to 200 phage particles.



2)- lysogenic cycle (الدورة غير التحللية)

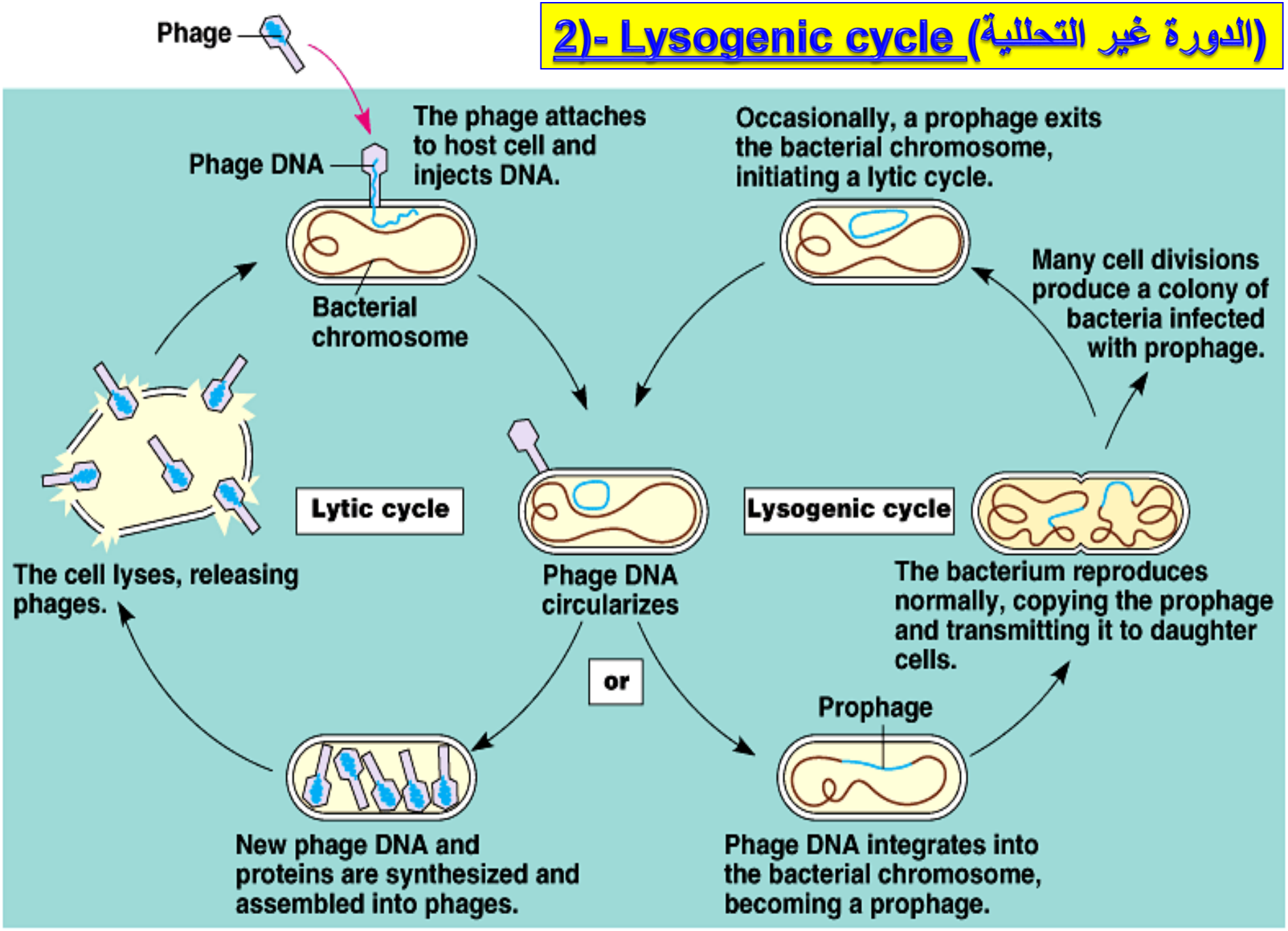
Phage lambda (λ)

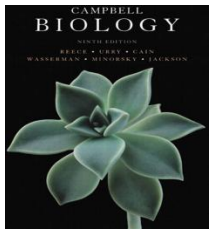


The phage genome usually replicates without destroying the host cell.

- **Phage lambda (λ) (Temperate phages) may use both lytic and lysogenic cycles.**
- **Within the host, the virus' circular DNA engages in either the lytic or lysogenic cycle.**
- **During a lytic cycle, the viral genome immediately turns the host cell into a virus-producing factory, and the cell soon lyses and releases its viral products.**

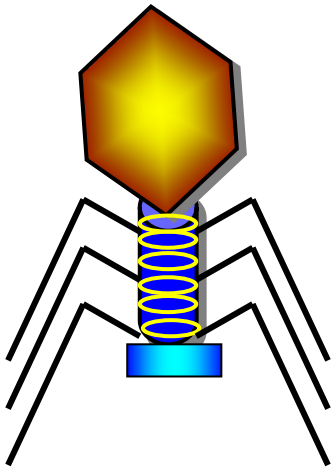
2)- Lysogenic cycle (الدورة غير التحللية)





Summary

Phage T4



Many tail fibres

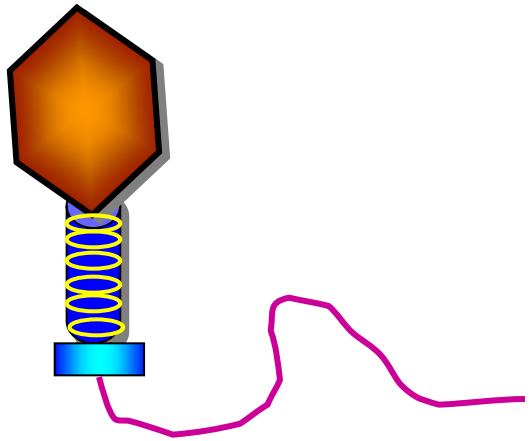
(virulent virus)

فيروس مميت

lytic cycle

(الدورة التحللية)

Phage lambda (ג)



Only 1 tail fibre

Temperate virus

فيروس غير مميت أحيانا

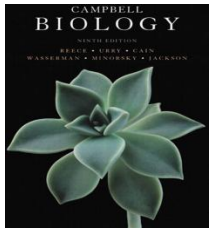
Lysogenic cycle

(الدورة غير التحللية)

and/or

lytic cycle

(الدورة التحللية)



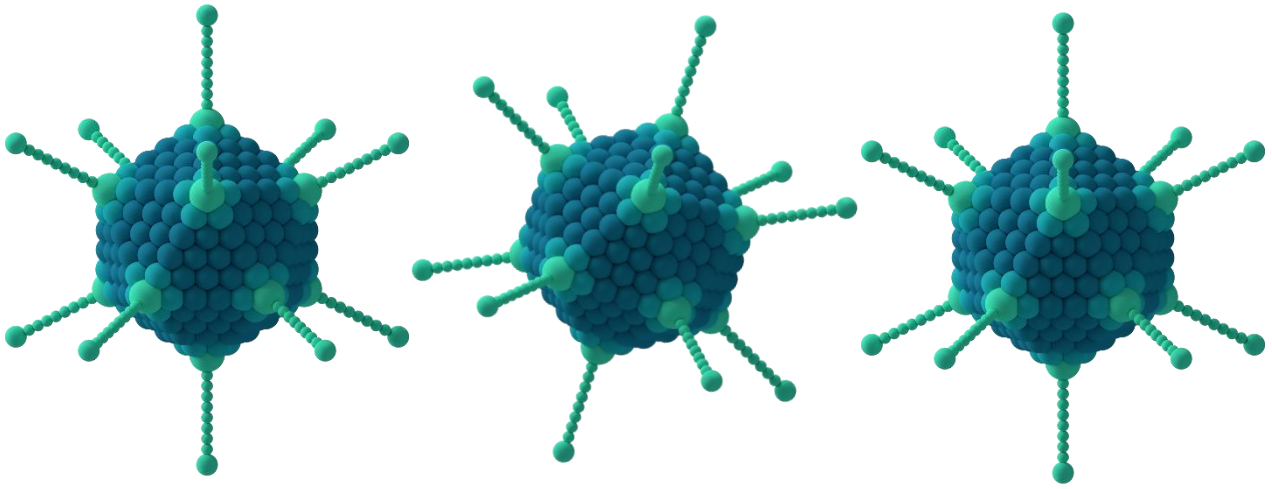
Summary: Characters of viruses

Most viruses of eukaryotes attack specific tissues. eg. Human cold viruses infect only the cells lining the upper respiratory tract, and AIDS virus binds only to certain white blood cells (Immune system).

- **DNA enclosed in a protein coat** (sometimes, membranous envelope also)
- **Can be crystallised** يتبلور
- **They lack** يفتقد **enzymes for metabolism**
- **Have no ribosomes for making their own proteins**
- **Reproduce only within a living host cell** (obligate parasitism تطفل إجباري).
- **Each type of a virus infects a limited range of host cells** (host range مدى الإصابة)

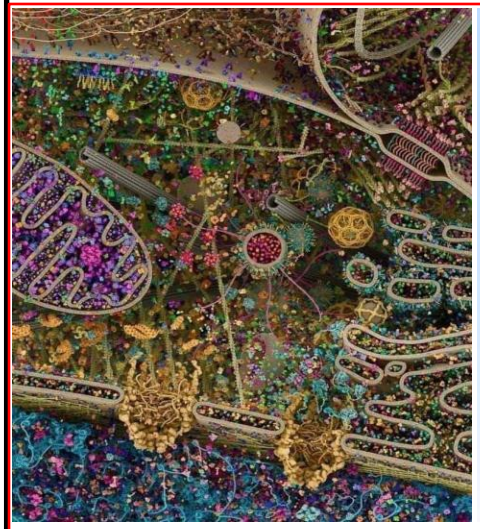
Viruses are host specific

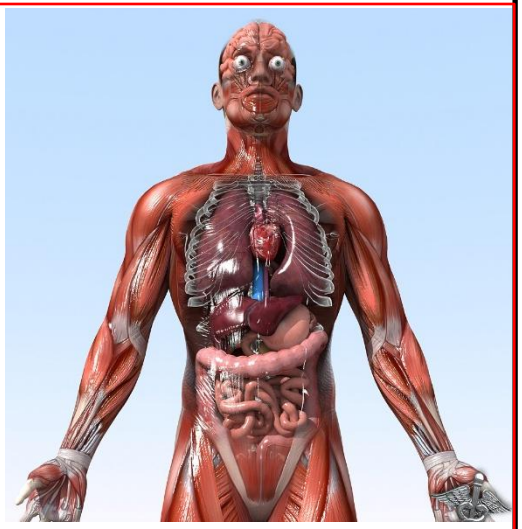
- a protein on the surface of the virus has a shape that matches a molecule in the plasma membrane of its host, allowing the virus to recognize the host cell.



General Animal Biology

Zoo-109 | علم الأحياء | 109- حـيـن





For Pre-Medical Students | **Common First Year**

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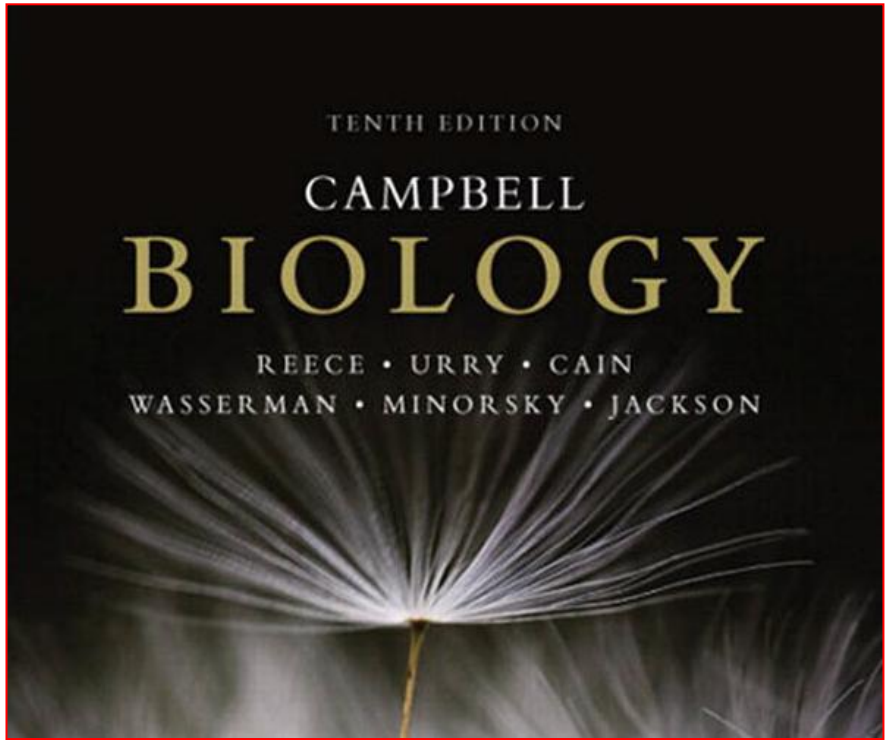
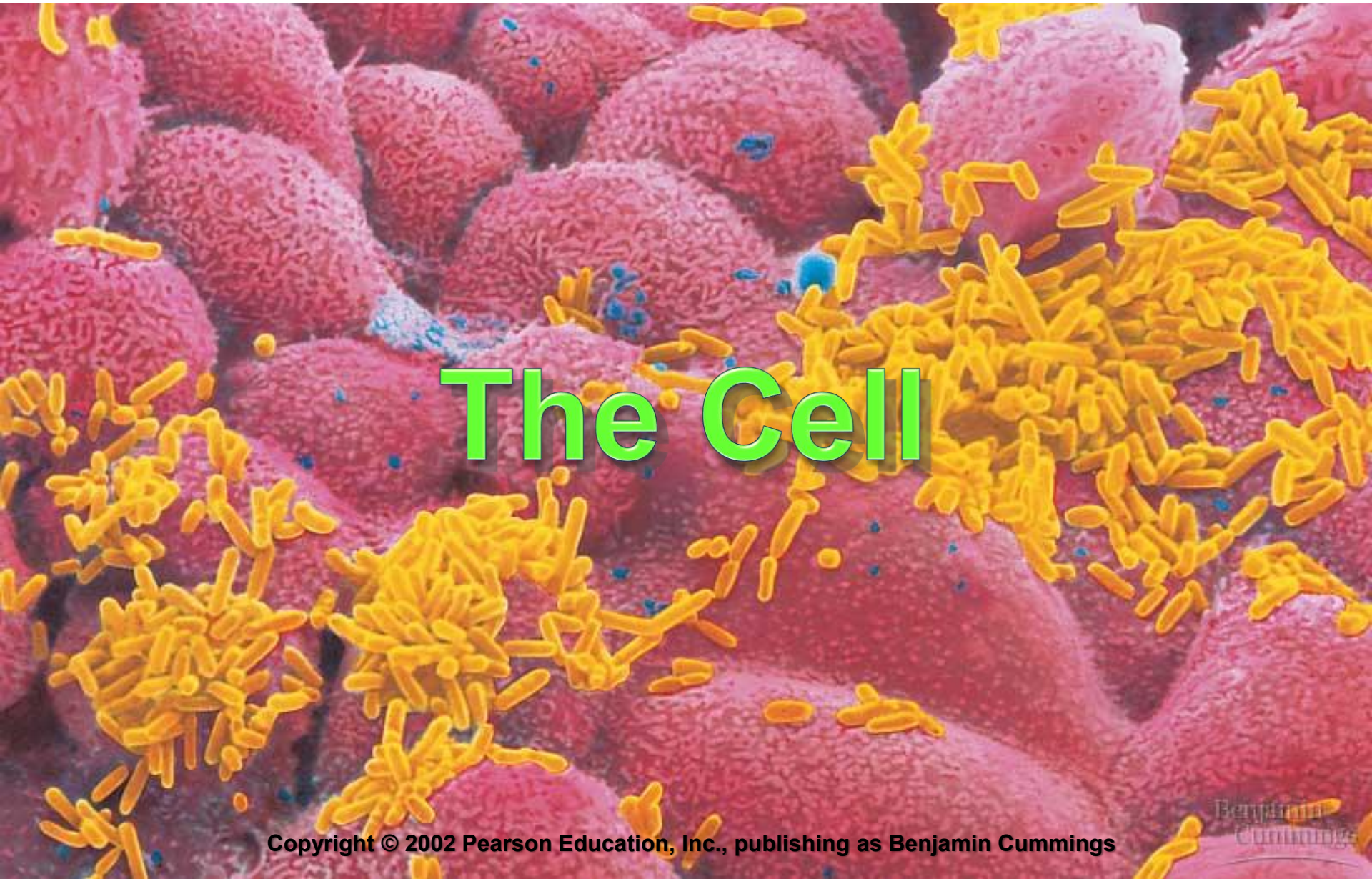
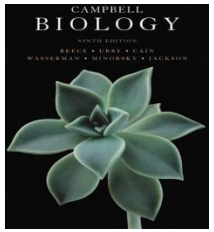




The Cell

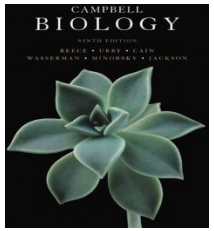


Objectives

- **The Cell:** Discovery of the Cell
- **The Cell Theory.**
- **Types of cells.**
- **The two main Domains of Living Organisms (Prokaryotes and Eukaryotes).**
- **Similarities between Prokaryotic and Eukaryotic Cells**
- **Differences between Prokaryotic and Eukaryotic Cells**

The Cell: Discovery of the Cell

- The first person to see cells was Robert Hooke in 1665.
- He was looking at a thin slice of cork through a microscope
- He found what he described as "tiny rooms" that he called cells



The Cell Theory

- In 1838, the German botanist Matthias Schleiden concluded that all plants were composed of cells
- In 1839, Theodor Schwann concluded the same thing for animals
- In 1855, Rudolf Virchow noted that all cells come from other cells

The cell theory states that:

1) all living organisms are made of one or more cells,
2) cells are the basic units of structure and function, and
3) cells come only from pre-existing cells.

A cell is the smallest unit that can carry on all of the processes of life

Living Cells

Types of cells

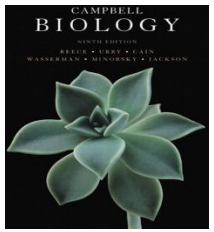
بدائية النواة

Bacteria and related micro-organisms

البكتيريا وكائنات دقيقة شبيهة بها

حقيقية النواة

All other forms of life



Domains of life

A)- Prokaryota بدائيات النواة

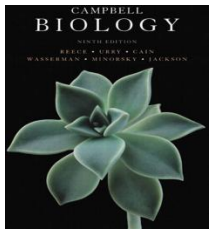
Contains 2 Kingdoms:

1. **Archaea**, مملكة البدائيات وتضم البكتيريا البدائية
2. **Bacteria** (Eubacteria), مملكة االبكتيريا الحقيقية

B)- Eukaryota حقيقيات النواة

Contains 4 Kingdoms:

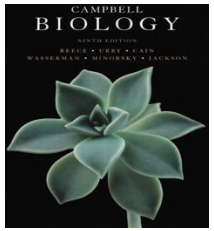
1. **Fungi** مملكة الفطريات
2. **Protista** مملكة الطلائعيات
3. **Plantae** مملكة النباتات
4. **Animalia** مملكة الحيوانات



Prokaryotic and eukaryotic cells differ in size and complexity

Similarities أوجه التشابه

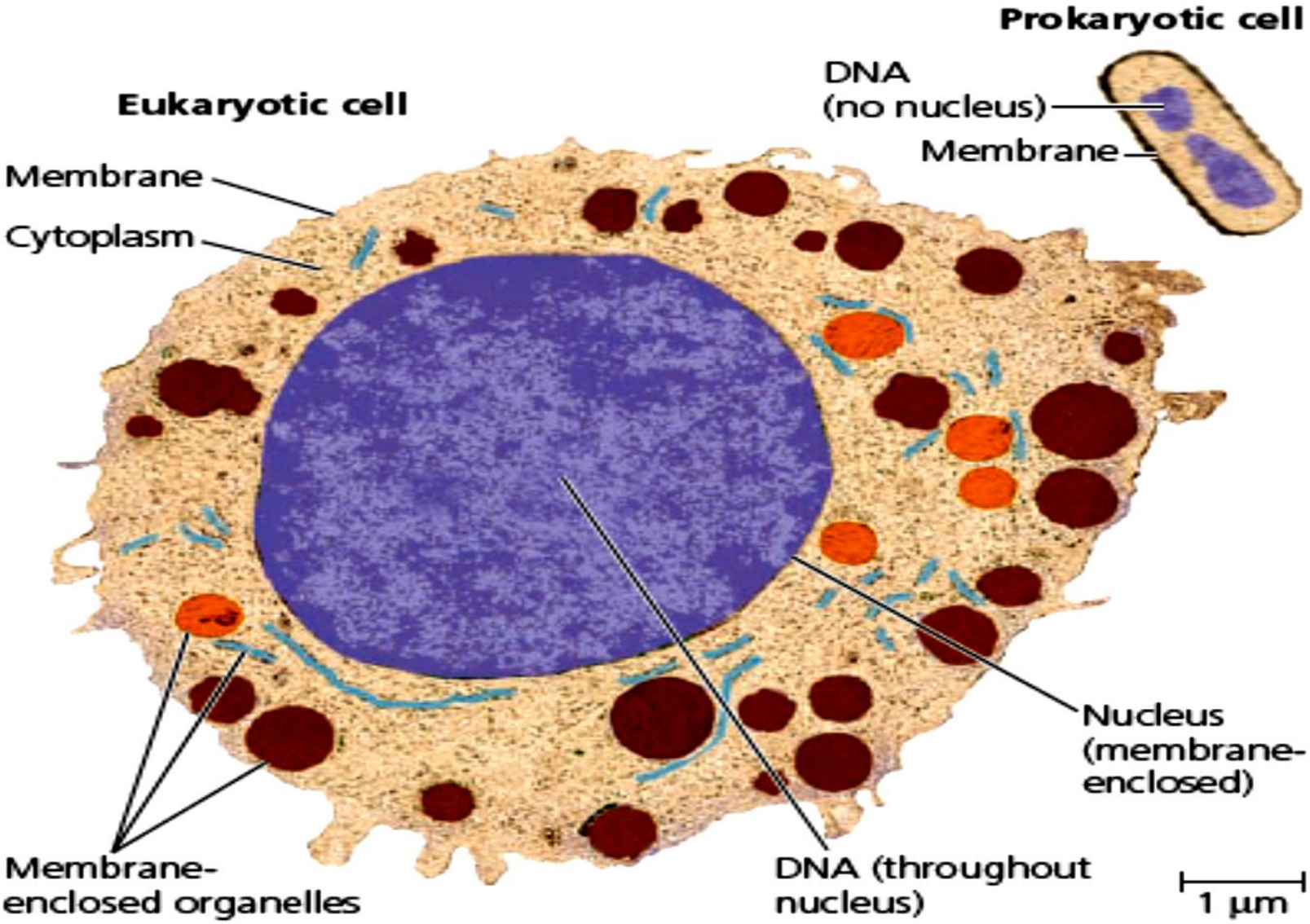
- All cells are surrounded by a plasma membrane غشاء بلازمى.
- The semi-fluid substance المادة شبه السائلة within the cell is called "cytosol", السيتوبلازم containing the cell organelles عِضيات الخلية.
- All cells contain chromosomes which have genes in the form of DNA.
- All cells have tiny organelles عضيات صغيرة called "*Ribosomes*" that make proteins.



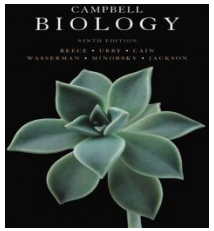
Prokaryotic and eukaryotic cells differ in size and complexity

Differences أوجه الإختلاف

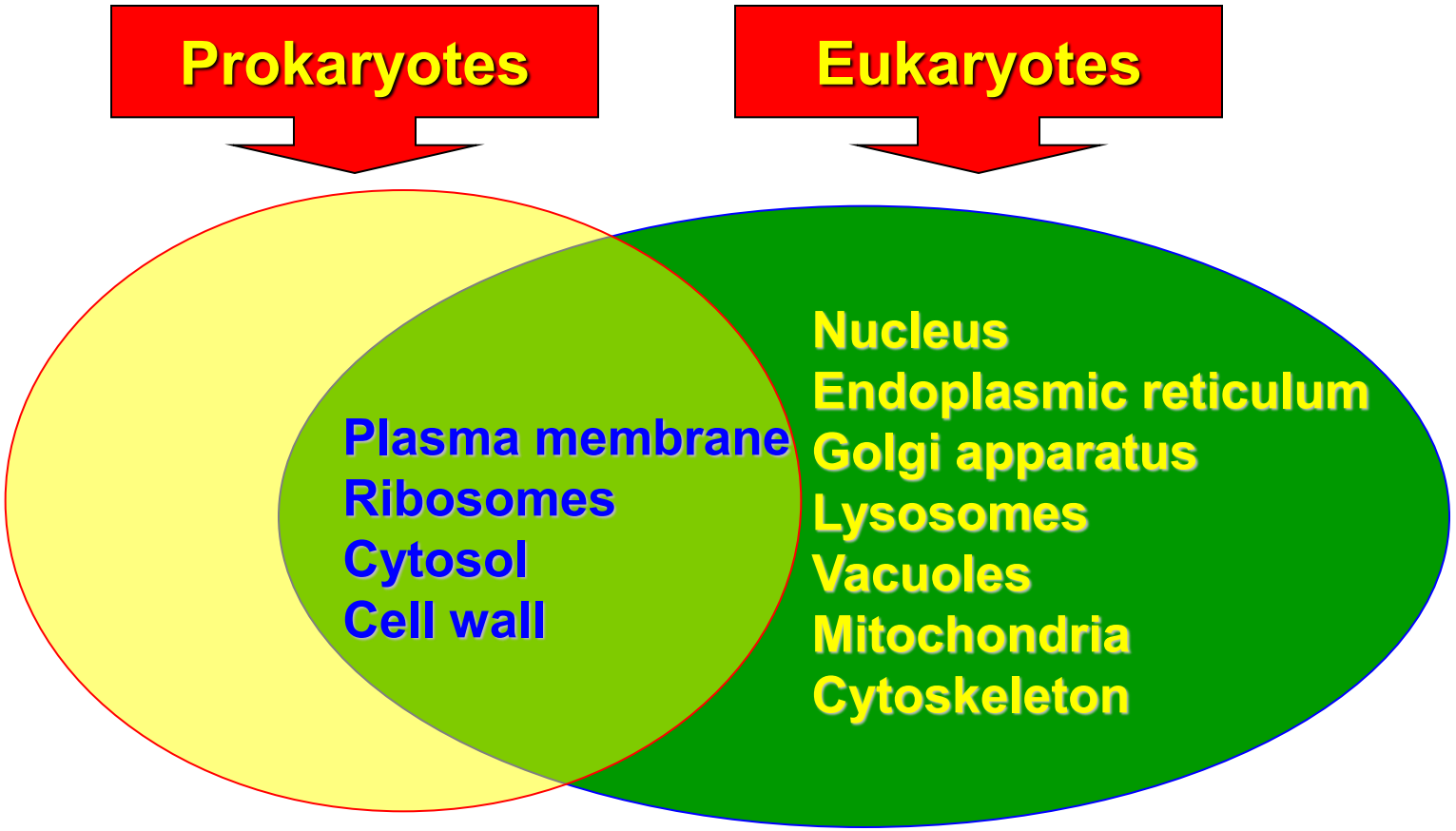
1. Eukaryotes have a nucleus, while prokaryotes do not.
2. Eukaryotes have membrane-bound organelles, while prokaryotes do not.
3. Eukaryotic cells are, on average, ten times the size of prokaryotic cells.
4. The DNA of eukaryotes is much more complex and therefore much more extensive than the DNA of prokaryotes.
5. The DNA of prokaryotes floats freely inside the cell; the DNA of eukaryotes is held within its nucleus and associated with histones (proteins)
6. Prokaryotes have a cell wall composed of peptidoglycan. Many types of eukaryotic cells also have cell walls, but none made of peptidoglycan.
7. Eukaryotes undergo mitosis and meiosis; while prokaryotes divide by binary fission (simple cell division)

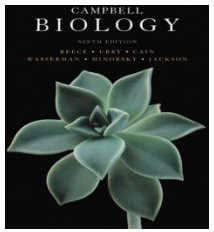


▲ **Figure 1.4** **Contrasting eukaryotic and prokaryotic cells in size and complexity.**



Comparison and Contrast





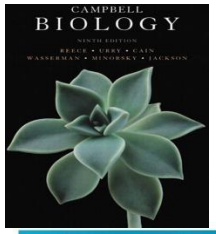
A)- Prokaryotes:

What are Prokaryotes?

- **Prokaryotes are single-celled (**Unicellular**) organisms that** *do not have a membrane-bound true nucleus*, **and can live in nearly every environment on earth.**

- **Although tiny, prokaryotes differ greatly in their genetic traits, their modes of nutrition, however, their habitats are similar.**

- **Based on genetic differences, prokaryotes are grouped into two major Domains:**
  - **Domain Archaea**
  - **Domain Bacteria.**



1. Domain: Archaea

- Archaea are extremophiles, "مُحب للظروف القاسية" of extreme environments and can be classified into:

a)- Extreme halophiles مُحب للملوحة:

- live in such saline places as the Great Salt Lake and the Dead Sea.
- Some species require an extremely salty شديدة الملوحة environment to grow.

b)- Extreme thermophiles مُحب للحرارة live in hot environments.

- The optimal temperatures for most thermophiles are 60 - 80°C.

General Animal Biology

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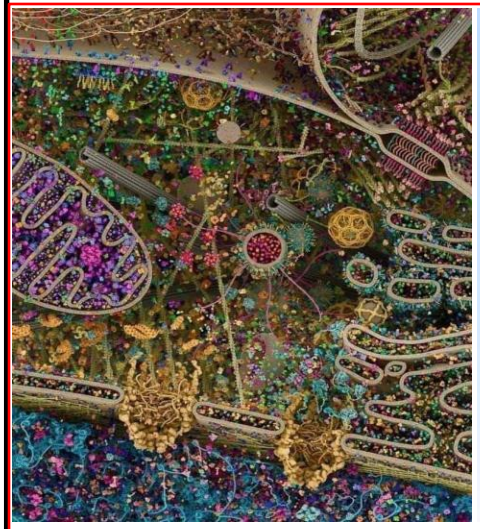

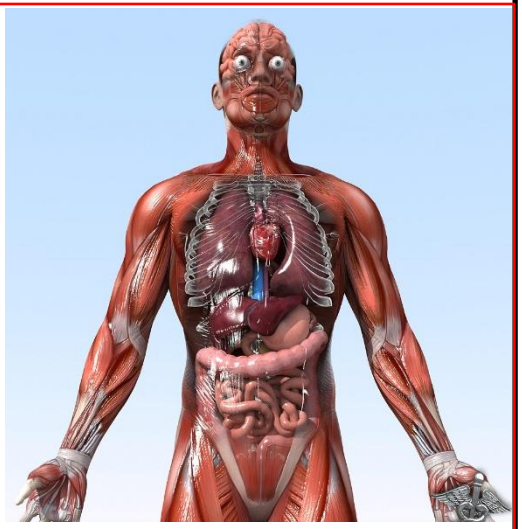

For Pre-Medical Students | **Common First Year**

السنة الأولى المشتركة - المسار الصحي

1447-H - 2026

Reference: *Campbell, N. A. and Reece, J. B. (2014). Biology (10th edition). Pearson Education. Inc. USA.*

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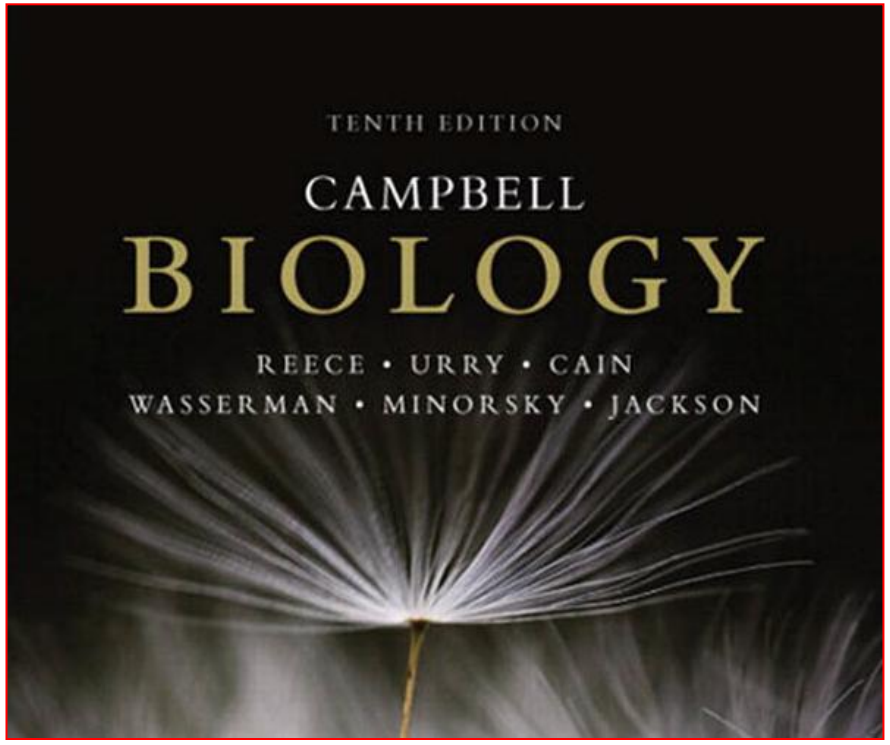
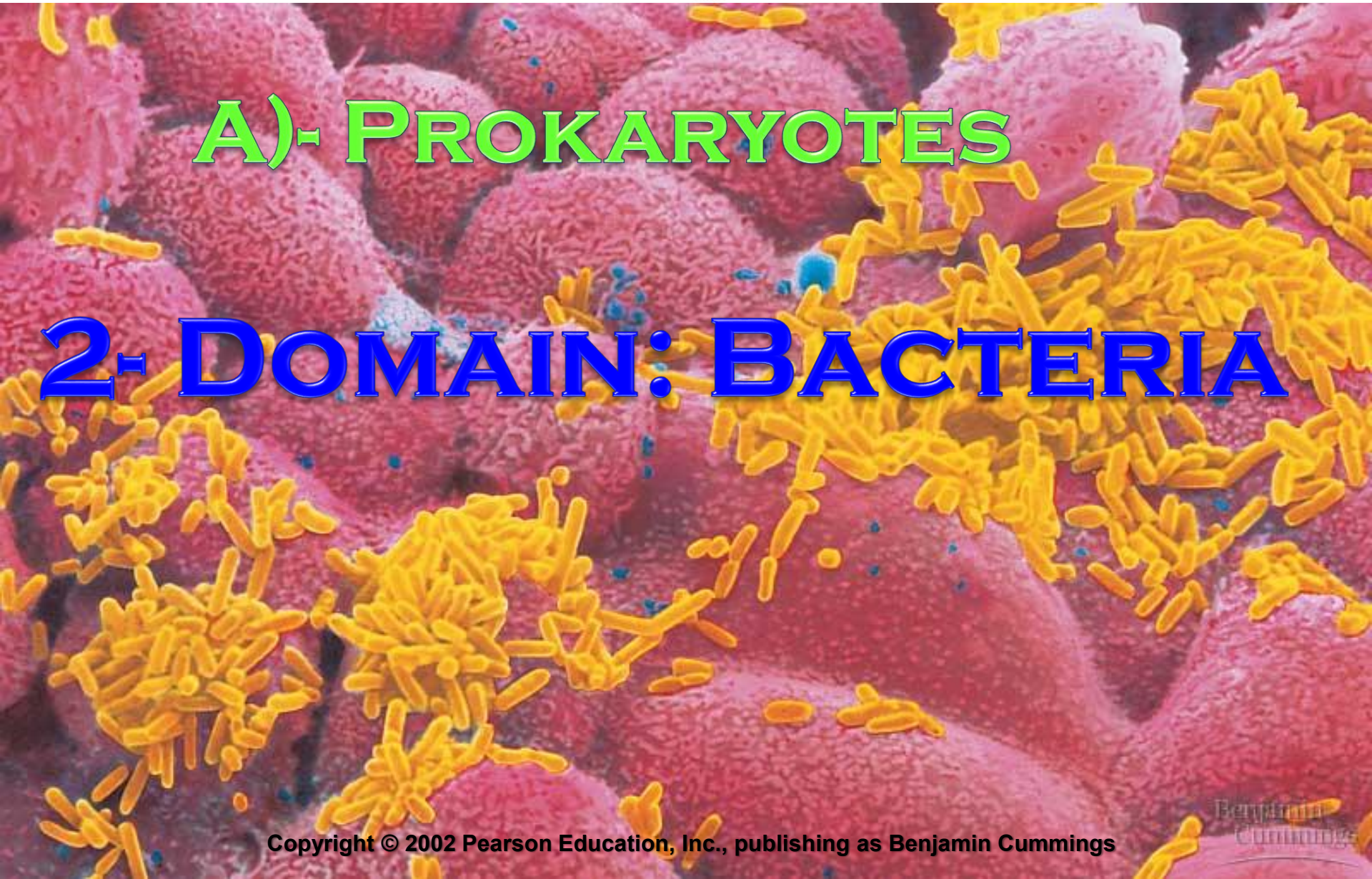
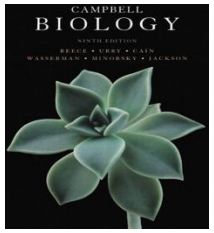




A)- Prokaryotes

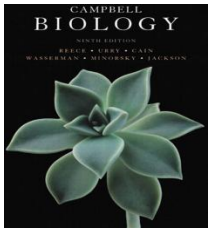
2- Domain: Bacteria



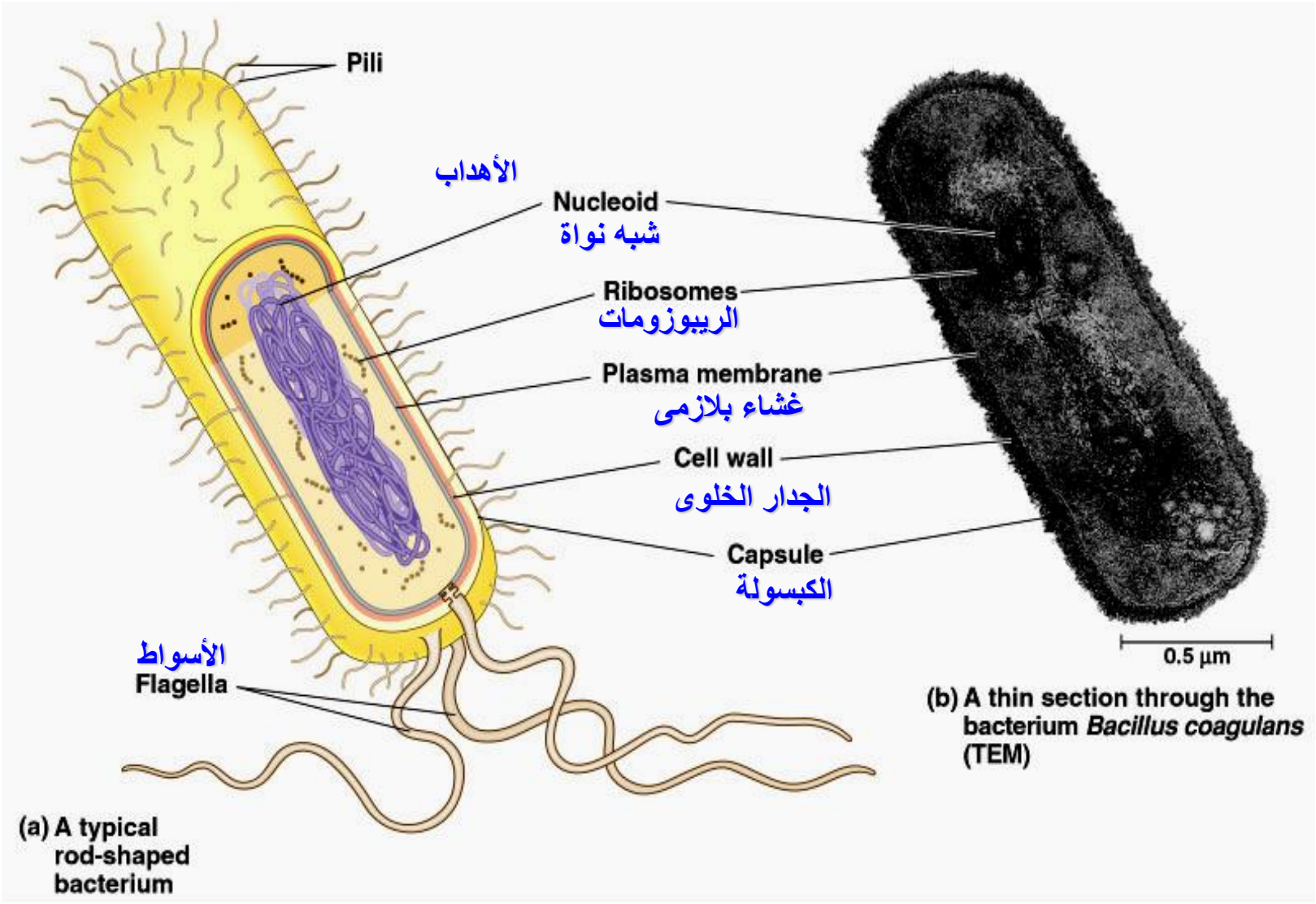
Objectives

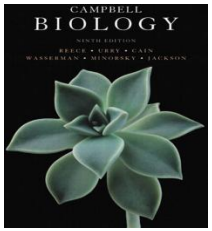
2)- Bacteria

- Structure of the bacterial cell.
- Shapes of bacteria.
- The Gram's stain.
- Reproduction of bacteria.
- Major Nutritional Modes.

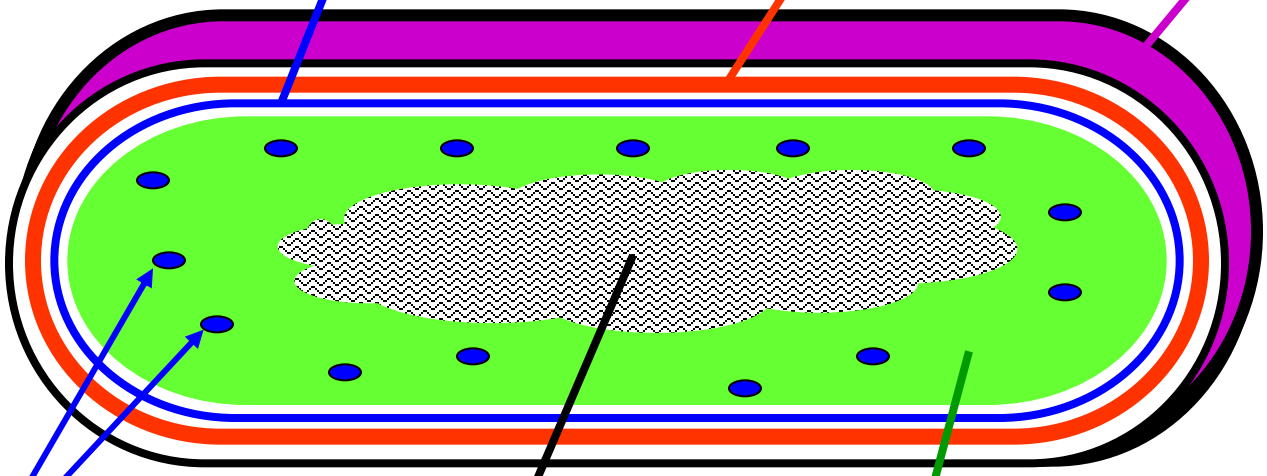


Structure of Bacteria Cell





Structure of Bacteria Cell



Plasma membrane

Cell Wall

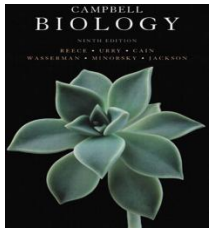
Capsule

Ribosomes

Nucleoid

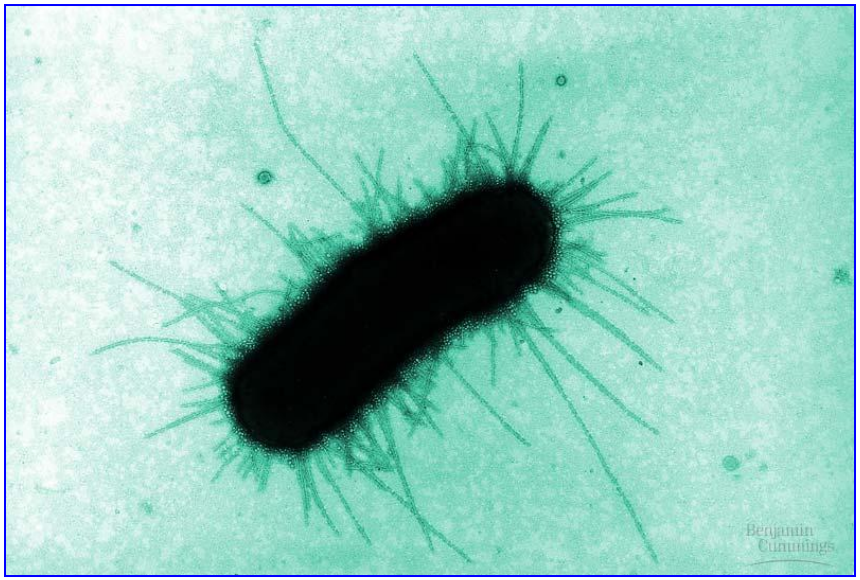
Cytoplasm

(Cytosol)

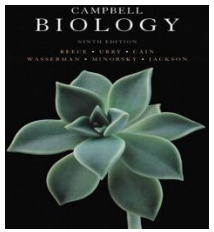


I - Bacterial capsule

- **Many bacteria secrete a sticky protective layer called capsule outside the cell wall.**
- **Capsule has the following functions وظائف:**



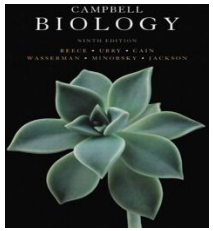
1. **Adhere** تثبيت **bacterial cells to their substratum** السطح.
2. **Increase bacterial resistance** المقاومة **to host defenses** مناعة العائل.
3. **Stick** (تلصق) **bacterial cells together when live in colonies.**
4. **Protect** تحمى **bacterial cell.**



II - The bacterial cell wall

- **In all prokaryotes, the functions of the cell wall are as follow:**
  1. **Maintains** تحافظ **the shape of the cell,**
  2. **Affords physical protection** توفر الحماية الطبيعية
  3. **Prevents the cell from bursting (**إنفجار**) in a hypotonic environment** البيئة ذات التركيز الأسموزى المنخفض.
- **Most bacterial cell walls contain**

  PEPTIDOGLYCAN **(a polymer of modified sugars cross-linked by short polypeptides).**
- **The walls of Archaea lack (**تفتقد**) peptidoglycan.**



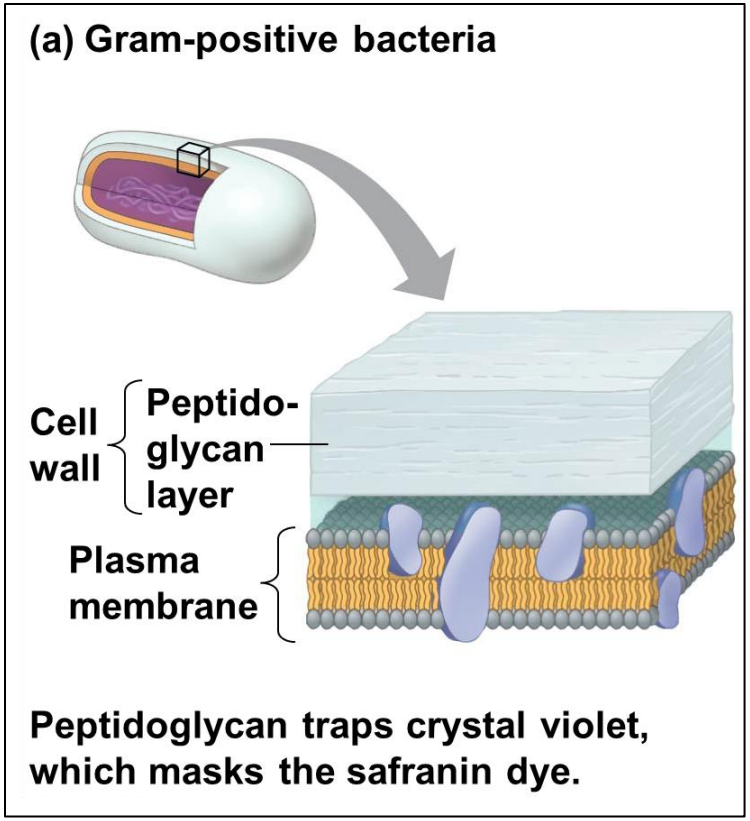
The Gram's stain: صبغة جرام

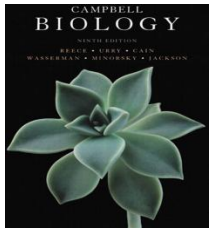
Developed by the Danish physician "Hans Christian Gram" in 19th century

- **It is a tool for identifying** تعريف **bacteria, based on differences in their cell walls.**

- **A)- Gram-positive (Gram +ve) bacteria:**

- **Their cell walls have large amounts** كمية كبيرة **of peptidoglycans that react with Gram's stain (appear violet-stained** تُصبغ بنفسجيا**).**

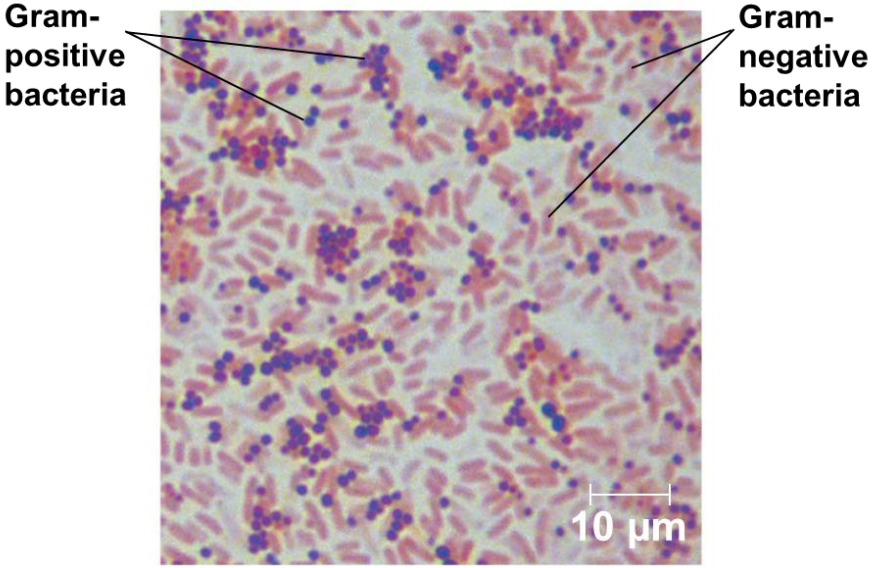


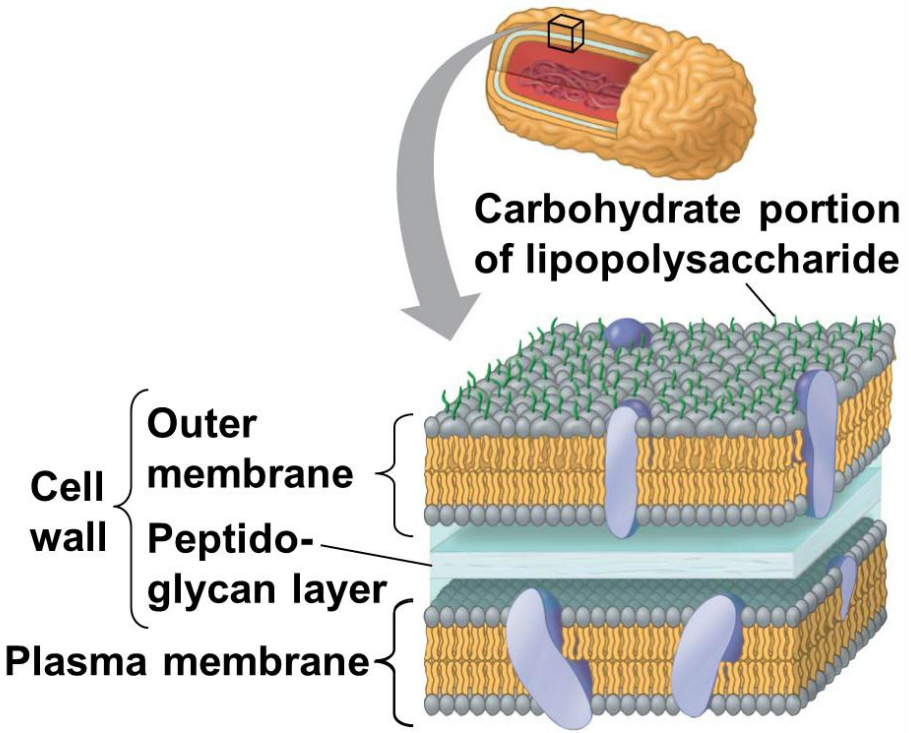


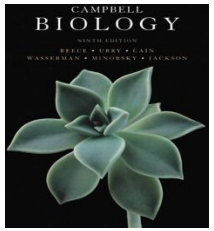
The Gram's stain: صبغة جرام

- **B)- Gram-negative (Gram -ve) bacteria:**

- **their cell walls have small amount of peptidoglycan. So, they do not react (**or very weakly react**) with Gram's stain (appear red-stained** تصبغ باللون الأحمر**)**



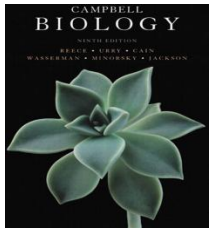




Summary of Gram's stain: صبغة جرام

- **Gram Staining: Most species of bacteria are classified into two categories based on the structure of their cell walls as determined by a technique called the Gram stain.**
  - **Gram-positive bacteria have a thick layer of peptidoglycan in their cell wall, and they appear violet under a microscope after the Gram-staining procedure.**
  - **Gram-negative bacteria have a thin layer of peptidoglycan in their cell wall, and they appear reddish-pink under a microscope after the Gram-staining procedure.**

- **Most Gram-negative species are *pathogenic* (ممرضة) *more threatening* (أكثر خطورة) than gram-positive species.**
- **Gram-negative bacteria are commonly *more resistant* أكثر ممانعة to antibiotics للمضادات الحياتية than gram-positive ones.**



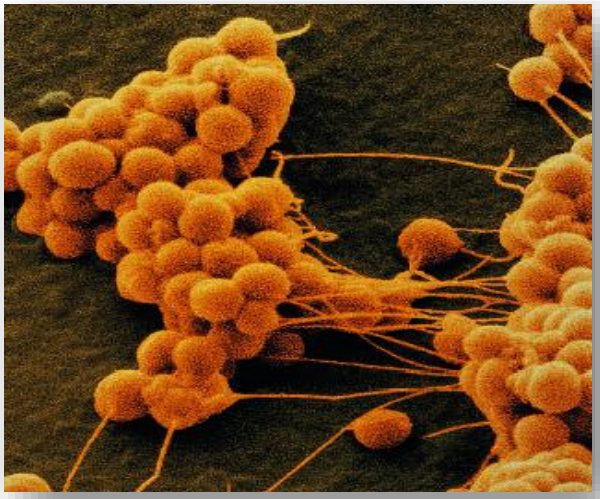
Shapes of Bacteria

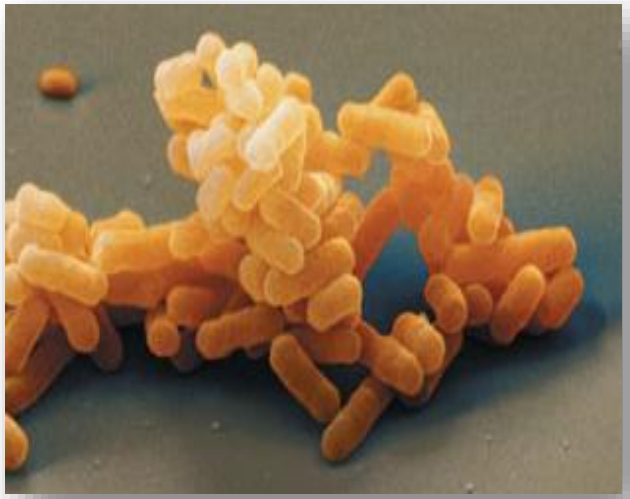
Bacteria are of four shapes: *spiral-shaped, sphere-shaped, rod-shaped, and more other shapes*.

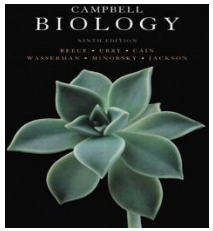
A. **Spiral shaped** (حلزونية الشكل) **bacteria in the form of spirilla (singular, *spirillum*) or vibrio (comma like). An example of spirella is *Spirillum volutans***

B. **Sphere-shaped** (كروية الشكل) **bacteria are called cocci (singular, *coccus*). An example of cocci is *Micrococcus luteus*.**

C. **Rod-shaped** (عصوية الشكل) **bacteria are called bacilli (singular, *bacillus*). An example of bacilli is *Bacillus sabtilis*.**



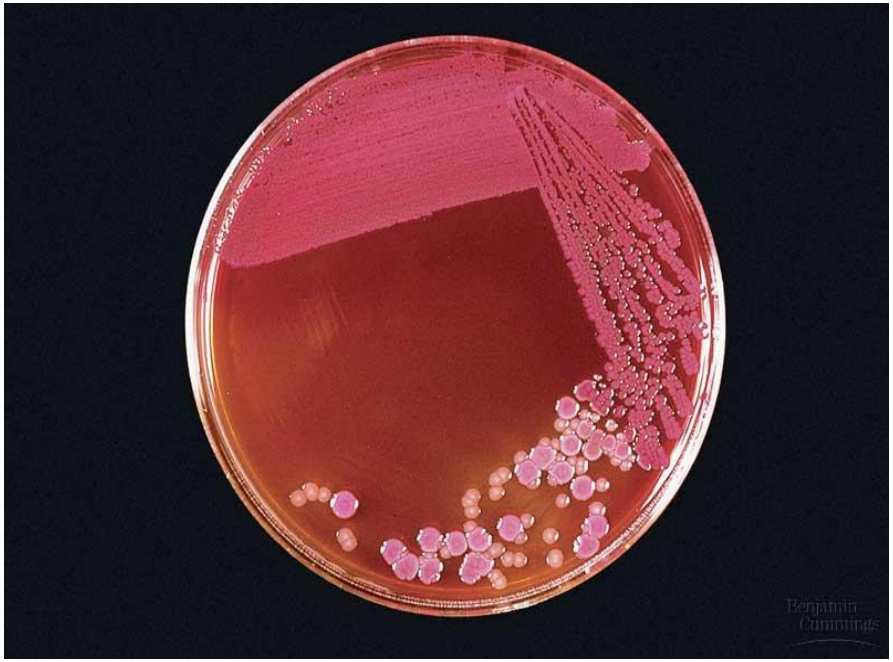


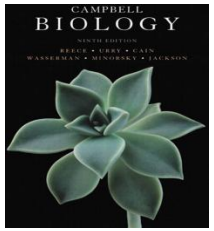


Reproduction of Bacteria

التكاثر في البكتريا

- **Prokaryotes reproduce** (تتكاثر) **only asexually** (لا جنسيا) **by binary fission** (الإنقسام الثنائي البسيط).
- **A single cell produces a colony of offspring.**

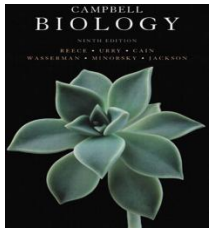




Nutrition of Prokaryotes
التغذية في بدائيات النواة

- **Nutrition refers to how an organism obtains energy and a carbon from the environment to build the organic molecules of its cells.**

- **Prokaryotes are grouped (صُنِفَت) into four categories (أنواع) according to how they obtain energy and carbon.**



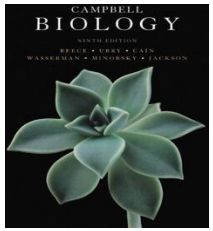
Nutrition of Prokaryotes
التغذية في بدائيات النواة

A)- Source of Energy

- ***Phototrophs*** (ضوئية التغذية): **Organisms that obtain <u>energy from light</u>.**
- ***Chemotrophs*** (كيميائية التغذية): **Organisms that obtain <u>energy from chemicals</u> in their environment.**

B)- Source of Carbon

- ***Autotrophs*** (ذاتية التغذية): **Organisms that obtain <u>carbon from CO_2</u>.**
- ***Heterotrophs*** (متعدد التغذية): **Organisms that obtain <u>carbon from organic nutrients</u>.**



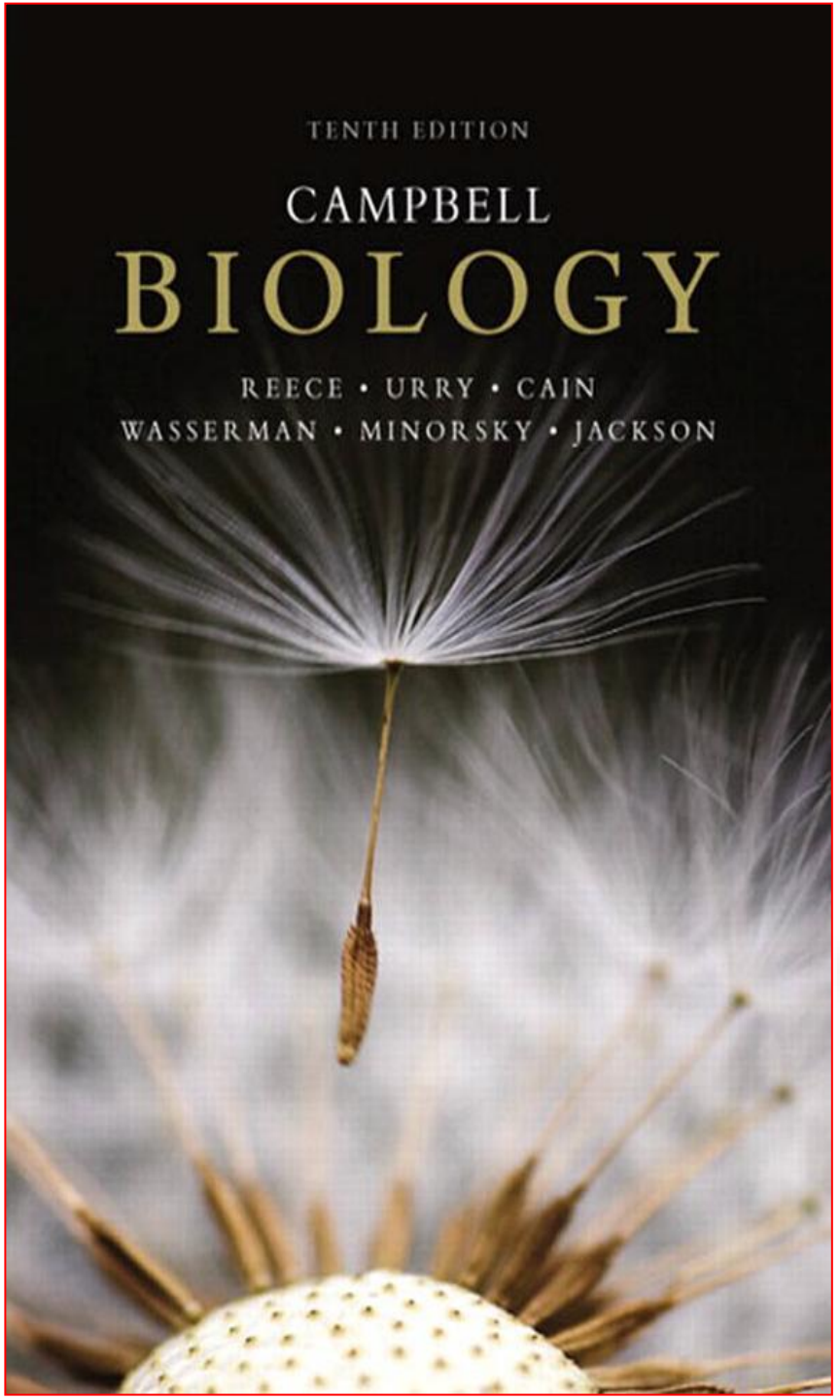
Major modes of nutrition

- **Photoautotrophs (ذاتية التغذية الضوئية):**
  use light energy as an energy source, and CO_2 as a carbon source to synthesize (تخلق) organic compounds.

- **Chemoautotrophs (ذاتية التغذية الكيميائية):**
  use chemical inorganic substances as an energy source, and CO_2 as a carbon source.

- **Photoheterotrophs (متعدد التغذية الضوئية):**
  use light as an energy source, and organic substances as carbon sources.

- **Chemoheterotrophs (متعدد التغذية الكيميائية):**
  use organic substances as a source for both energy and carbon.



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Zoology Department

General Animal Biology

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Thank you very much

شكرا جزيلا

Zoology Department