فسيولوجيا الأحياء الدقيقة
Microbial Physiology

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مكتب ٢ ب ٤٥

مقدمة
Introduction-L2

The Importance of Microorganisms in Physiology:

- **Short generation time.**
- **Small Size.**
- **Small genome Size.**
- **Nutritional Diversity.**

The Composition of *Escherichia coli*

- **To get an understanding of the number and size of bacterial cells:**
  - One gram of *E. coli* cell = **~10^{12} cells** = **one teaspoon**.
  - Greater than the human population.
- **<u>Atomic Composition:</u>**
  - **Major Components**: 55% C, 20% O, 14% N, 8% H.
  - **Minor Components**: 3% P, 2% K, 1% S.
  - **Trace Elements**: 0.2% Fe, 0.05% each of Ca. Mg, and Cl, and 0.3% total of Mn, Co, Cu, and Zn.

Cell Structure and Function

- **Bacterial Cell Structure:**

  - **Cell Wall**
    - Surrounds the cytoplasmic membrane.
    - It can directly reflect adaptive strategies involving:
      - ✓ Uptake (IN) and excretion (OUT).
      - ✓ Movement.
      - ✓ Protection.
      - ✓ Adhesion.
  - In some organisms, more than 25% of the bacterial genome is devoted to cell wall synthesis, regulation, and maintenance.

Cell Structure and Function

- **Bacterial Cell Structure:**
  - **Gram + Cell Wall:**
    - ❖ Rigid Structure.
    - ❖ Many-layered wall.
    - ❖ Based on a cross-linked polymer-**Peptidoglycan.**
    - ❖ Possess Teichoic acids within their cell wall:
      - ➢ Wall Teichoic Acids- Polymers made of Ribitol and phosphate. Also, it confer s antigenic specificity to the bacteria.
      - ➢ Membrane Teichoic Acids (Lipo-teichoic Acids)- polymers of glycerol and phosphate.

Cell Structure and Function

- **Bacterial Cell Structure:**
  - **Gram – membranes:**
    - ❖ Consists of outer and inner (cytoplasmic) membranes separated by the periplasm.
    - ❖ **Outer membrane**:
      - • Flexible outer phospholipid bilayer with an inner thin peptidoglycan layer.
      - • Strong negative charge help in evading phagocytosis.
      - • Acting as a barrier for antibiotics.
      - • Contains hydrophobic lipo-polysaccharides and lipoproteins.

Cell Structure and Function

- **Bacterial Cell Structure:**
  - **Gram – membranes:**
    - **Outer membrane**:
      - Porins: involved in the transport of materials.
      - Peptidoglycan layer: attaches to the outer membrane by a murien lipoprotein.
      - Lipopolysaccharides project outward from the outer membrane:
        - Comprised of three parts:
          a. Lipid A.
          b. Core sugar.
          c. variable polysaccharide (known as the **O-antigen**).
    - **Periplasm**:
      - A solution between the outer membrane and inner membrane.
      - Contains proteins that can be free/ attached to either membrane.
      - Proteins usually involved hydrolysis, reception and material transport.

Cell Structure and Function

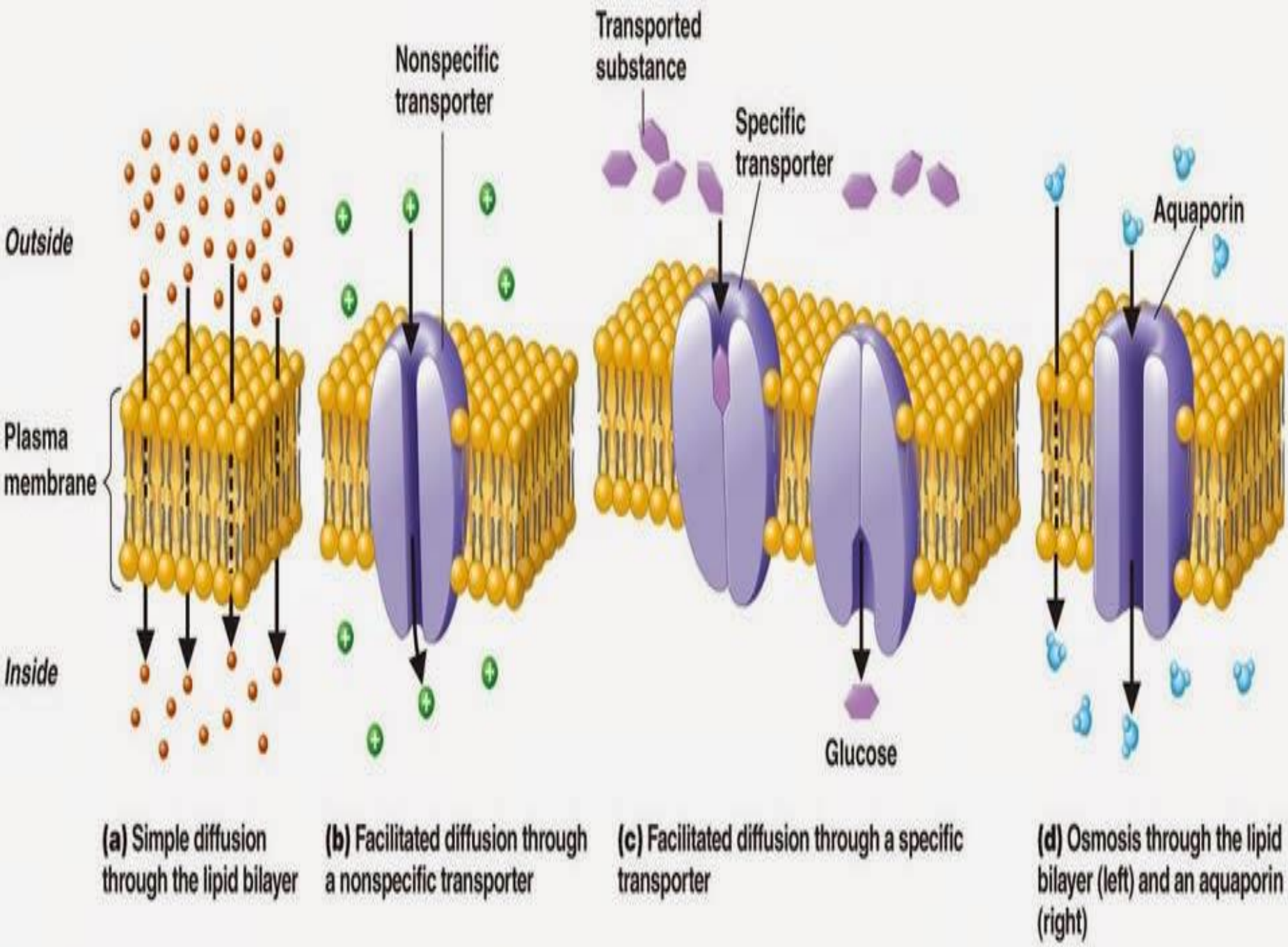
- **Bacterial Cell Structure:**
  - **Cytoplasmic (inner) membrane**:
    - Feature of both gram-positive and gram-negative cells.
    - A phospholipid bilayer.
    - A semi-solid fluid (GEL).
    - Allows membrane-components to pass throughout.
    - Peripheral or integral proteins associated with it.
    - Important in translocation of materials.

    - The prokaryotic membrane is involved in many metabolic activities:
      - Selective permeability.
      - Cell division.
      - Sporulation.
      - Electron transfer and ATP formation.
      - DNA replication and many others.

Cell Structure and Function

- **Bacterial Cell Structure:**
  - **Glycocalyx:**
    - Referred to as the capsule.
    - A gelatinous material made of different material (proteins or polysaccharides) in both eukaryotes and prokaryotes.
    - Depending of the attraction to the cell, it can be either
      - A capsule (discrete).
      - A slime layer (indiscrete).

  - **Permeability and Transport: Passive Transport** (Simple diffusion, facilitated diffusion, osmosis), **Active Transport** (antiport, symport, and uniport).

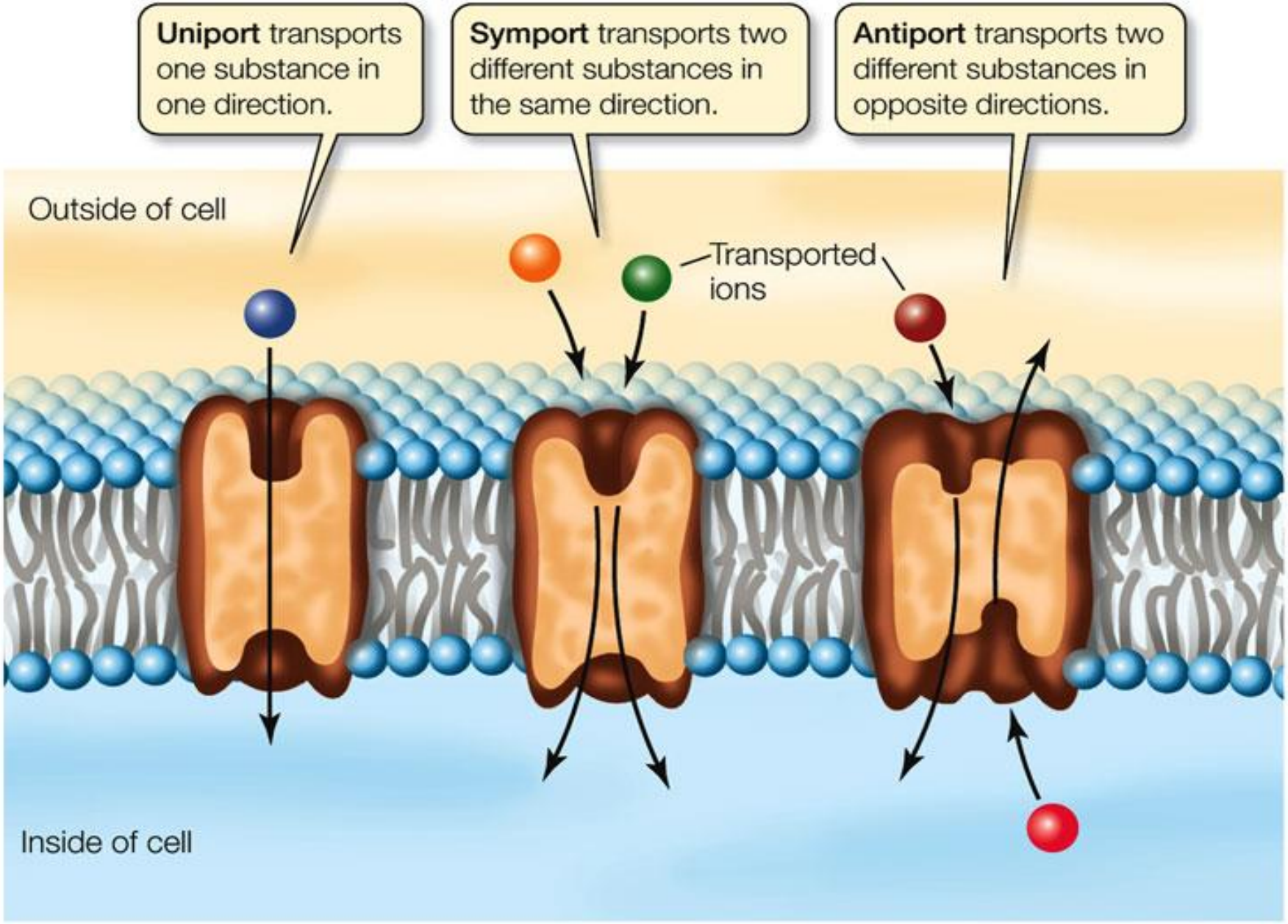


(a) Simple diffusion through the lipid bilayer

(b) Facilitated diffusion through a nonspecific transporter

(c) Facilitated diffusion through a specific transporter

(d) Osmosis through the lipid bilayer (left) and an aquaporin (right)



***LIFE 8e*, Figure 5.13**

Permeability and Transport

http://highered.mheducation.com/sites/0072495855/student_view0/chapter2/animation__how_diffusion_works.html

https://www.khanacademy.org/test-prep/mcat/cells/transport-across-a-cell-membrane/v/diffusion-and-osmosis

https://highered.mheducation.com/sites/9834092339/student_view0/chapter39/sodium-potassium_exchange_pump.html

https://highered.mheducation.com/sites/9834092339/student_view0/chapter39/active_transport_by_group_translocation.html

https://www.youtube.com/watch?v=ovHYKlHYpyA

QUESTIONS??