

Lecture-2

Principles of microbiology

الدكتورة أسماء الصالح

رقم المكتب 5T201

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Principles of Microbiology

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- The importance of microorganisms

1.2 Microbial Cells

- Cell chemistry and key structure
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- Cell functions: coding and metabolism.

1.3 Microorganisms and Their Environments

- Microbial interaction

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- Microorganisms as disease agents
- Microorganisms and agriculture
- Microorganisms and food
- Microorganisms, energy and their environment
- Microorganisms and their genetic resources
- Microbiology as a career

1.1 Microbiology and Microorganisms

The science of microbiology revolves around two themes:

1. Understanding basic life processes (basic biological science).
 - Microbes are excellent models for understanding cellular processes in unicellular and multicellular organisms
2. Applying that knowledge to the benefit of humans (applied biological science)
 - Microbes play important roles in medicine, agriculture, and industry

1.1 Microbiology and Microorganisms

The importance of microorganisms

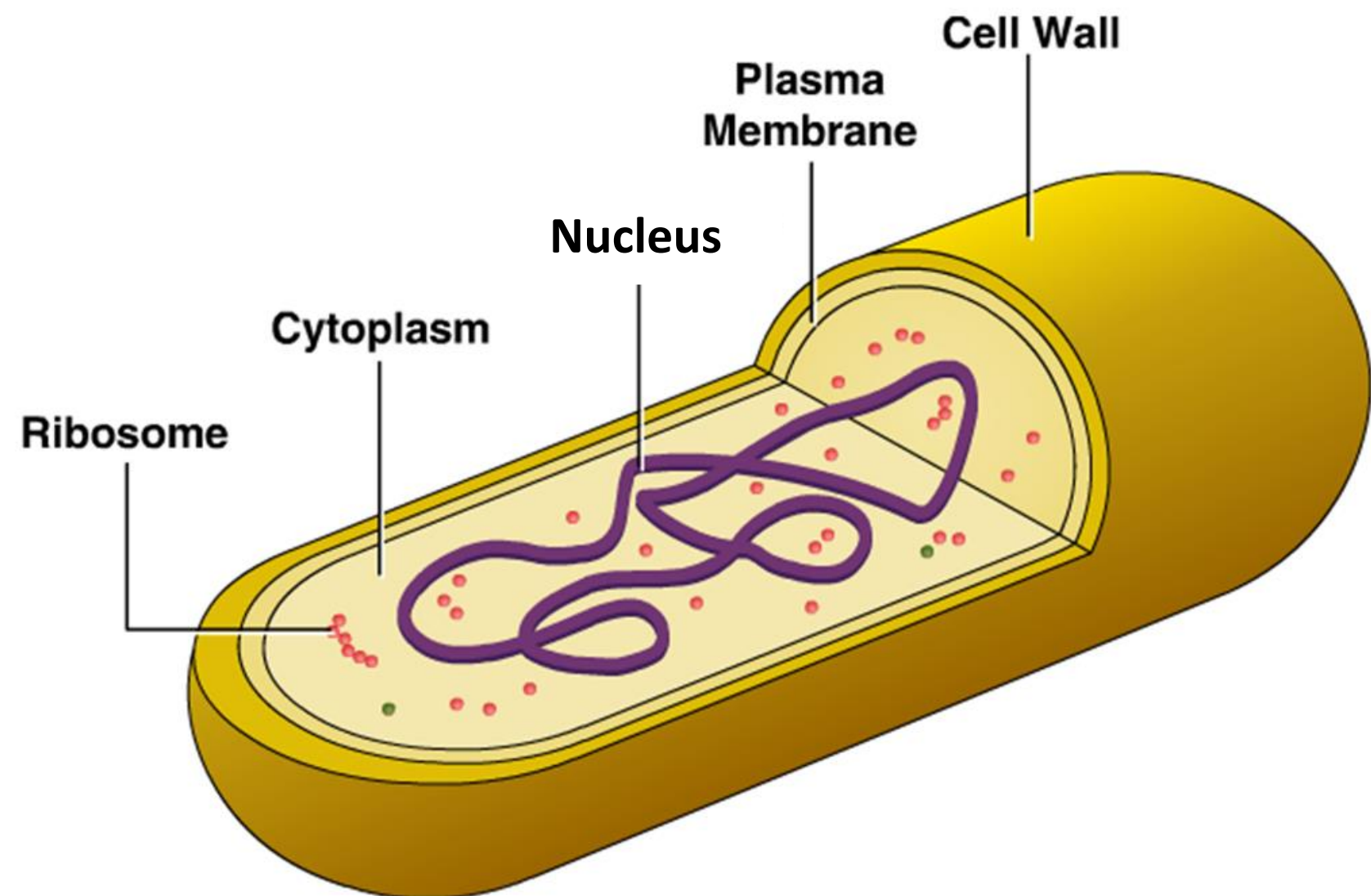
- Oldest and smallest form of life
- Largest mass of living material on Earth
- Carry out major processes for biogeochemical cycles
- Can live in places unsuitable for other organisms
- Other life forms require microbes to survive

1.2 Microbial cell

The Cell

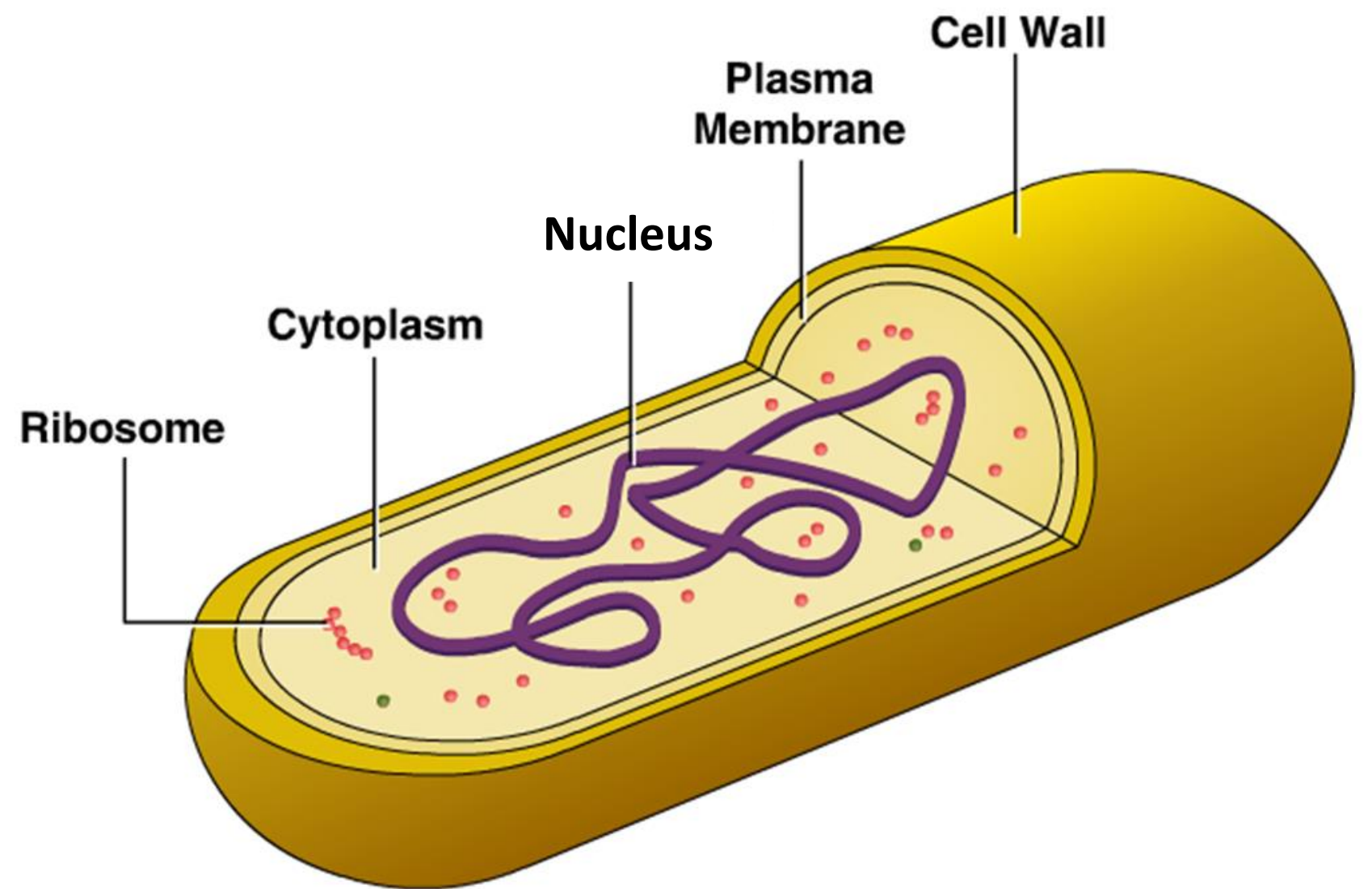
- A dynamic entity that forms the fundamental unit of life
- Contains 4 chemical components, form 95% of dry weight of the cell:

1. Proteins
2. Nucleic acids
3. Lipids
4. Polysaccharides



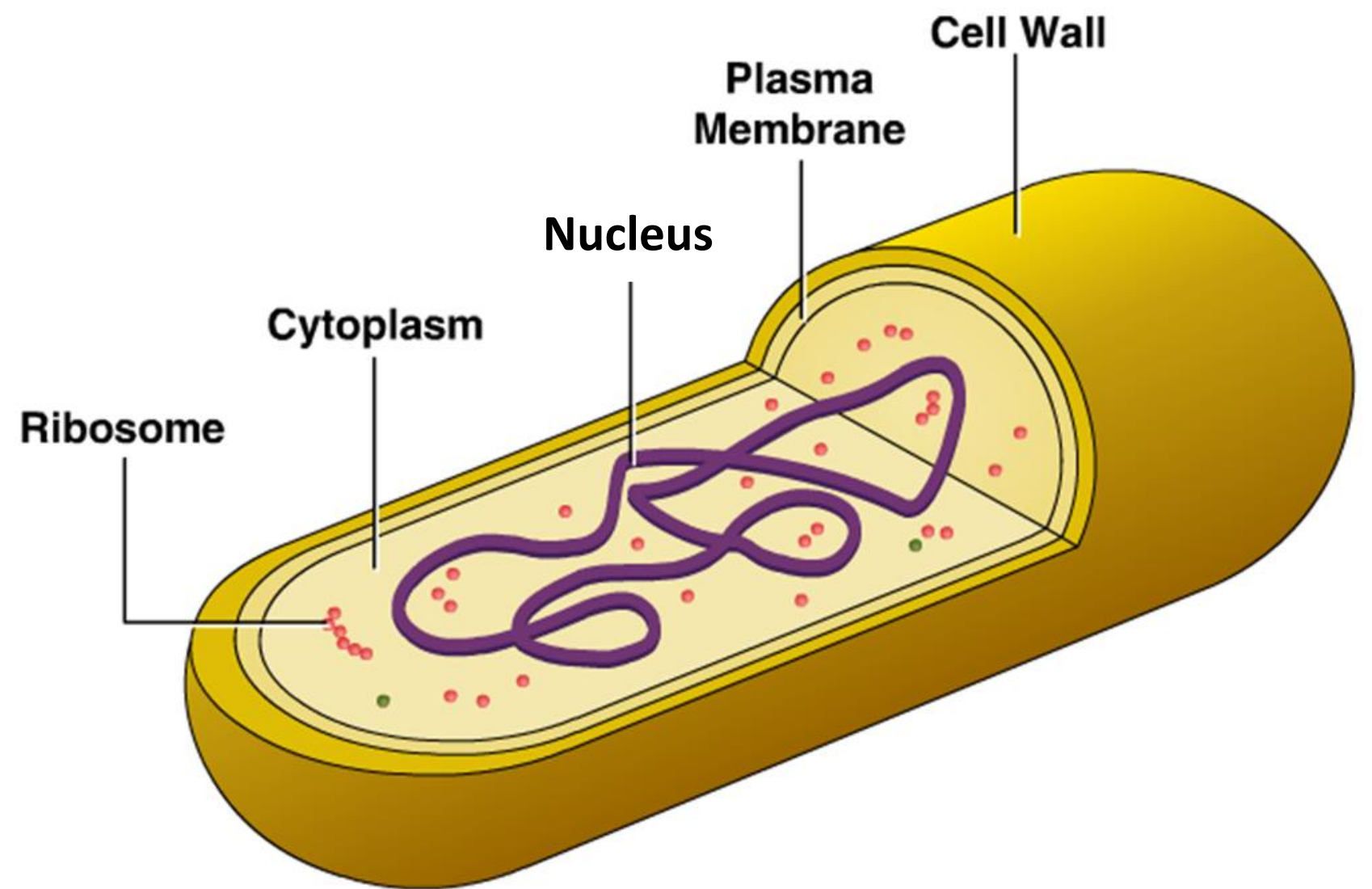
1.2 Microbial cell

- Cytoplasmic (cell) membrane
 - Barrier that separates the inside of the cell from the outside environment
- Cell wall
 - Present in most microbes, confers structural strength and prevents the cell from osmotic bursting

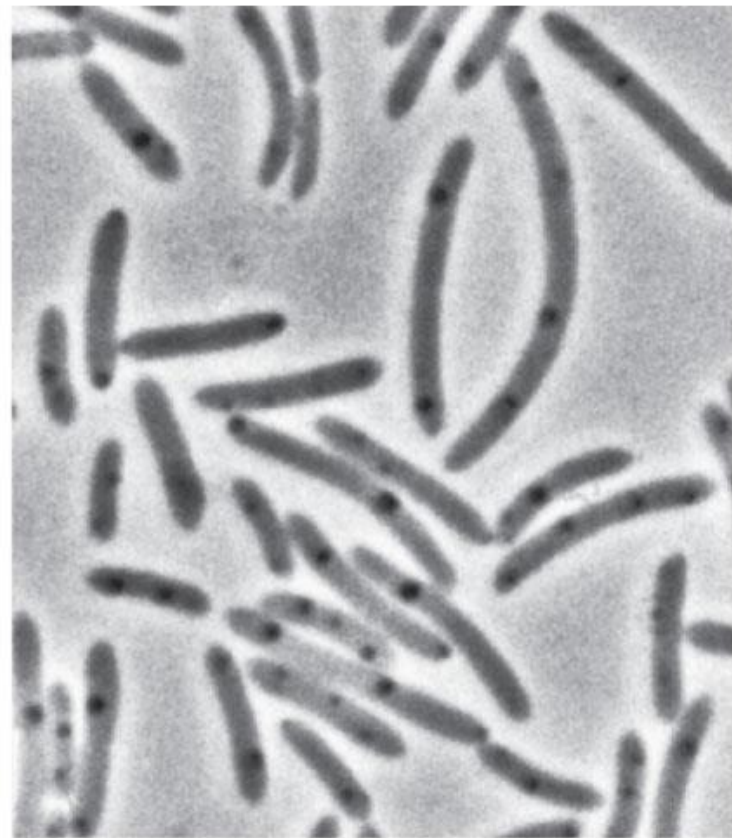


1.2 Microbial cell

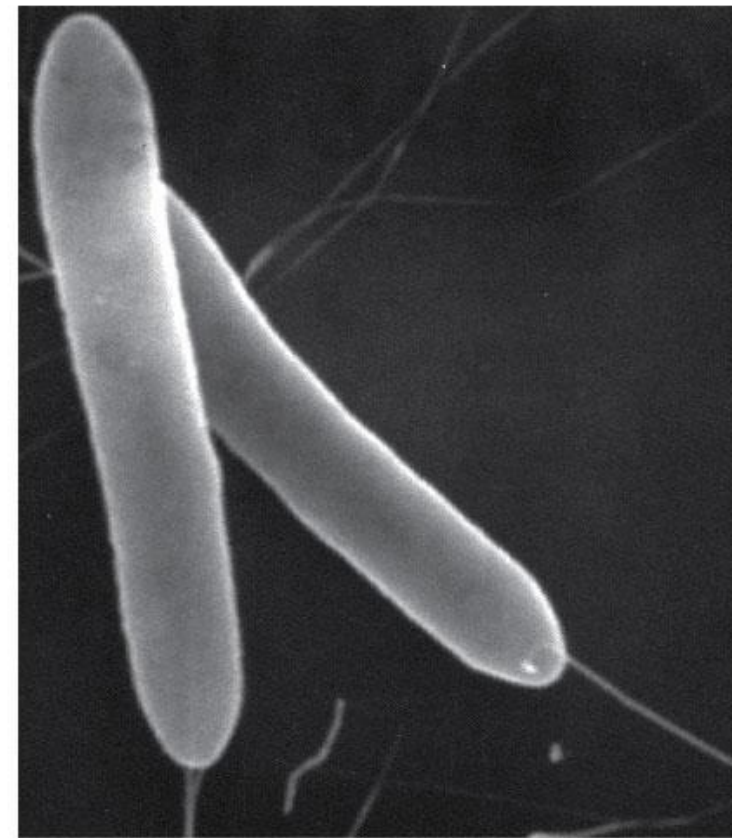
- Cytoplasm:
 - The fluid inside the cell contains various structures and chemicals
- Nucleus or nucleoid: contains
 1. DNA (the genome)
 2. Ribosomes (consisting proteins)
 3. RNA (new proteins are made)



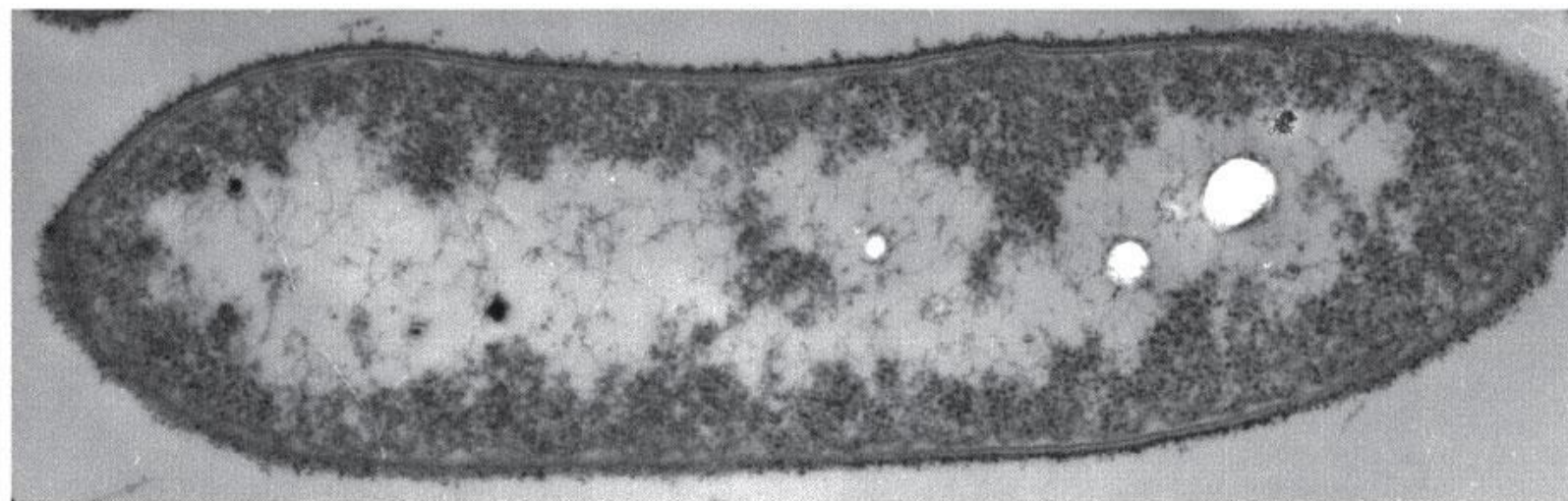
1.2 Microbial cell



(a)



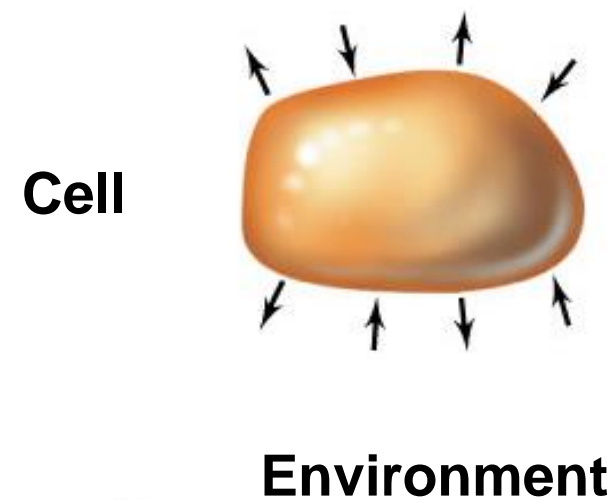
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1.2 Microbial cell

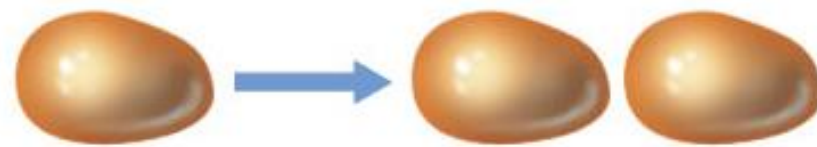
Characteristics of living systems



1- Compartmentalization and metabolism:

A cell is a compartment that takes up nutrients from the environment, transforms them, and releases wastes into the environment.

The cell is thus an *open system*.

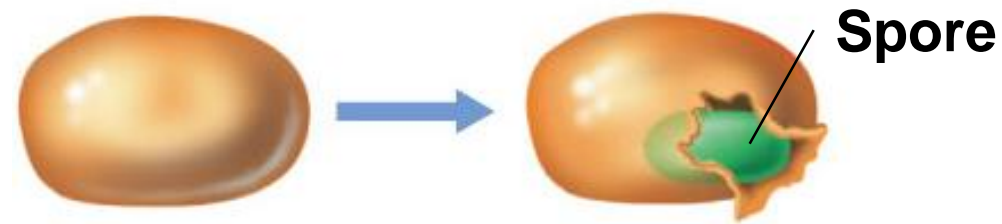


2-Growth

Chemicals from the environment are turned into new cells under the genetic direction of preexisting cells.

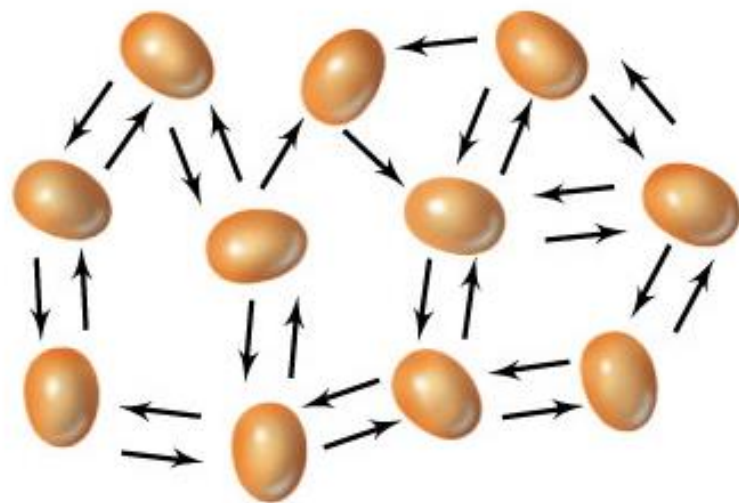
1.2 Microbial cell

Characteristics of living systems



3- Differentiation

Some cells can form new cell structures such as a spore, usually as part of a cellular life cycle.

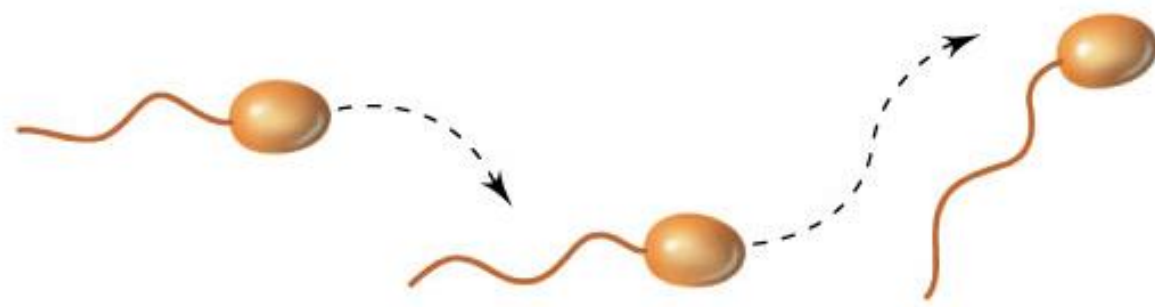


4- Communication

Many cells *communicate* or *interact* by means of chemicals that are released or taken up.

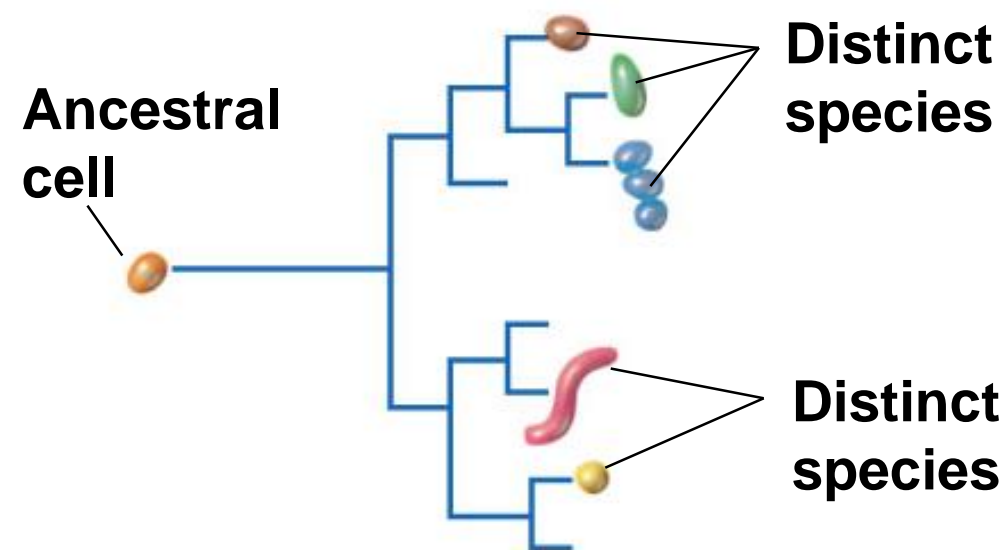
1.2 Microbial cell

Characteristics of living systems



5- Motility

Some cells are capable of self-propulsion



6- Evolution

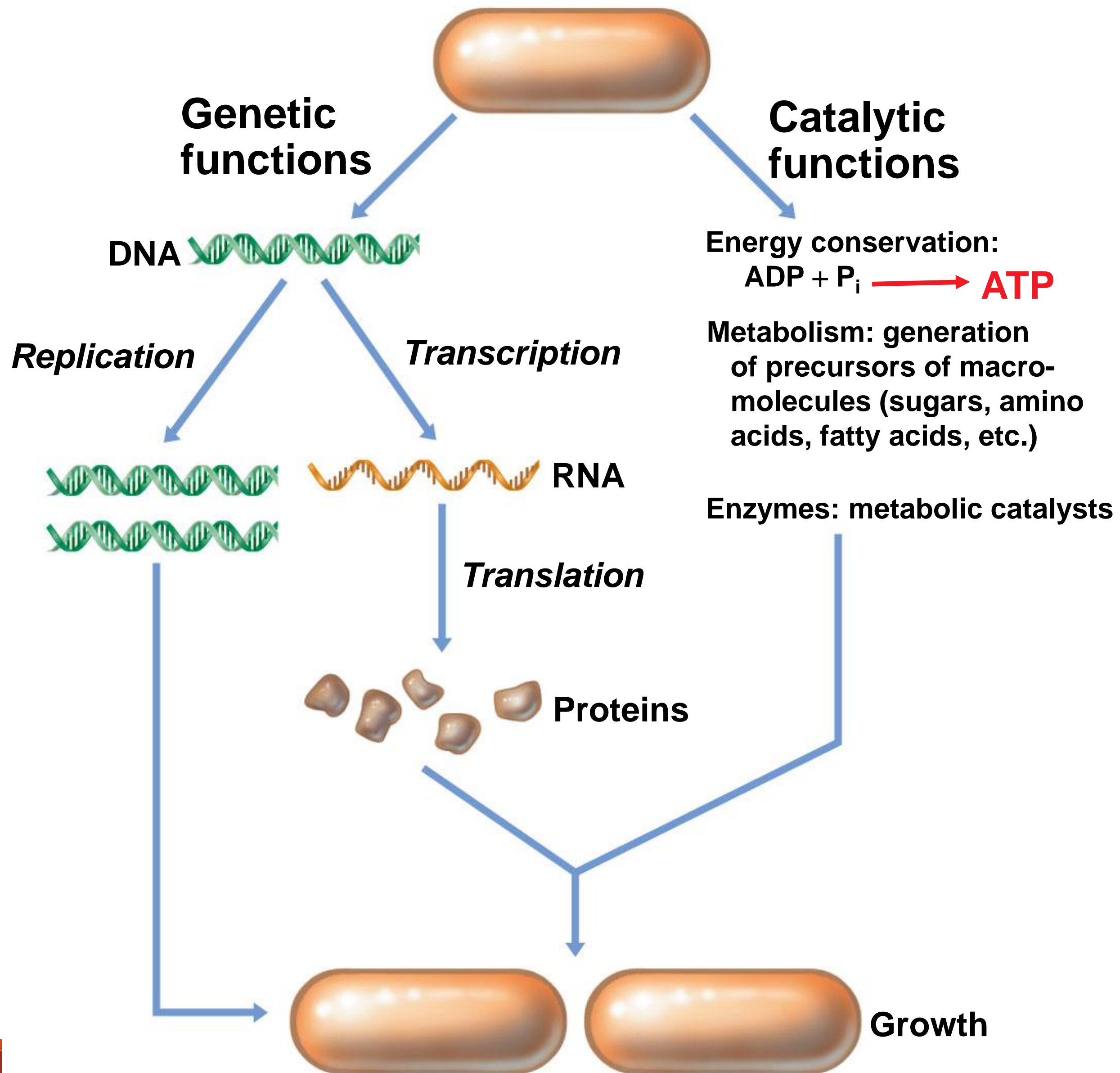
Cells contain genes and *evolve* to display new biological properties.

Phylogenetic trees show the evolutionary relationships between cells.

1.2 Microbial cell

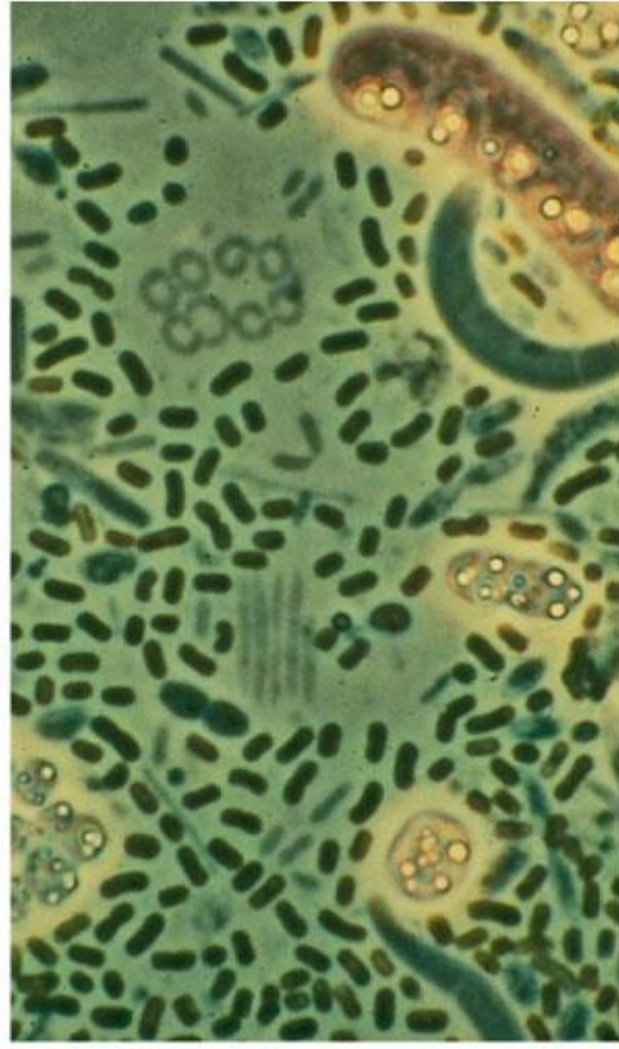
Cells as Catalysts and as Coding Devices

1. Cells carry out chemical reactions
 - Enzymes: protein catalysts of the cell that accelerate chemical reactions
2. Cells store and process information that is eventually passed on to offspring during reproduction through DNA (deoxyribonucleic acid) and evolution.
 - Transcription: DNA produces RNA
 - Translation: RNA makes protein



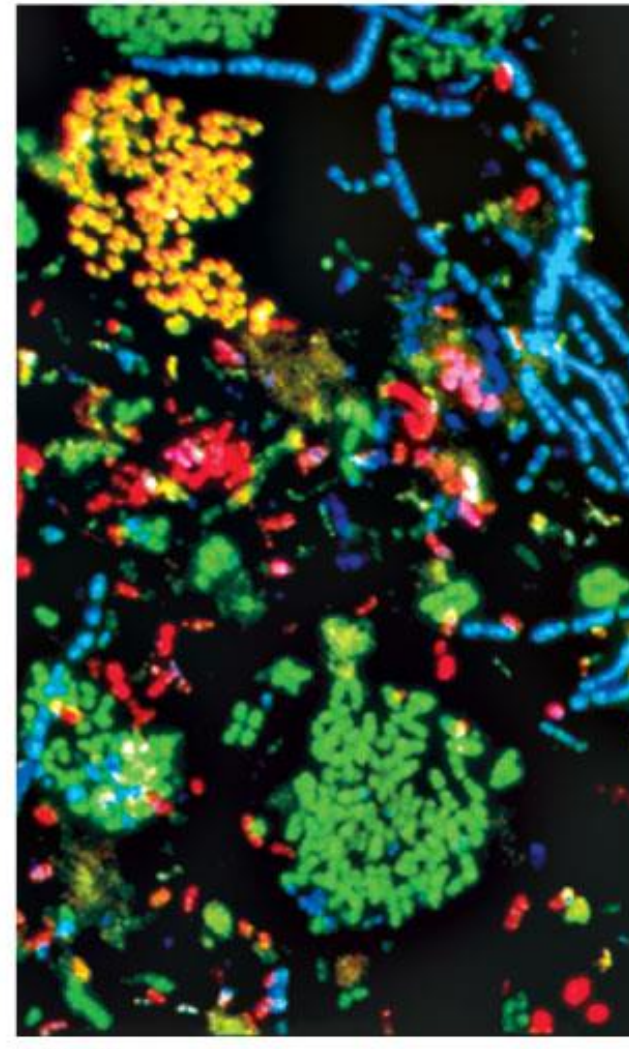
1.3 Microorganisms and Their Environments

1. Microorganisms exist in nature in populations of interacting assemblages called microbial communities.
2. The environment in which a microbial population lives is its habitat
3. Ecosystem refers to all living organisms plus physical and chemical constituents of their environment
4. Microbial ecology is the study of microbes in their natural environment



D. E. Caldwell

(a)



Jiri Snaidr

(b)



Ricardo Guerrero

(c)



1.3 Microorganisms and Their Environments

1. Diversity and abundances of microbes are controlled by resources (nutrients) and environmental conditions (e.g., temp, pH, O₂)
2. The activities of microbial communities can affect the chemical and physical properties of their habitats

1.3 Microorganisms and Their Environments

Microbes also interact with their physical and chemical environment

- Ecosystems greatly influenced (if not controlled) by microbial activities
- Microorganisms change the chemical and physical properties of their habitats through their activities
 - For example, removal of nutrients from the environment and the excretion of waste products



ANY QUESTIONS?

140MIC: Microbiology

140 حدق: علم الأحياء الدقيقة

Recommended websites:

<http://www.microbiologyonline.org.uk/>

<http://schaechter.asmblog.org/schaechter/> (small things considered)

<http://www.simhq.org/> (society of industrial microbiology and biotechnology)

<http://www.asm.org/> (American society of microbiology)

<http://www.theasm.org.au/> (The Australian society of microbiology)

<http://www.pearsonhighered.com/microbiologyplace/learn.html#lectures>

Recommended text books:

Brock's biology of microorganisms 12th edition (Madigan et al. 2009)

Microbiology principles and explorations (Black 2008)