

**Environmental microbiology  
CLS416**

**Lecture 1**

**Fundamentals of microbial ecology**

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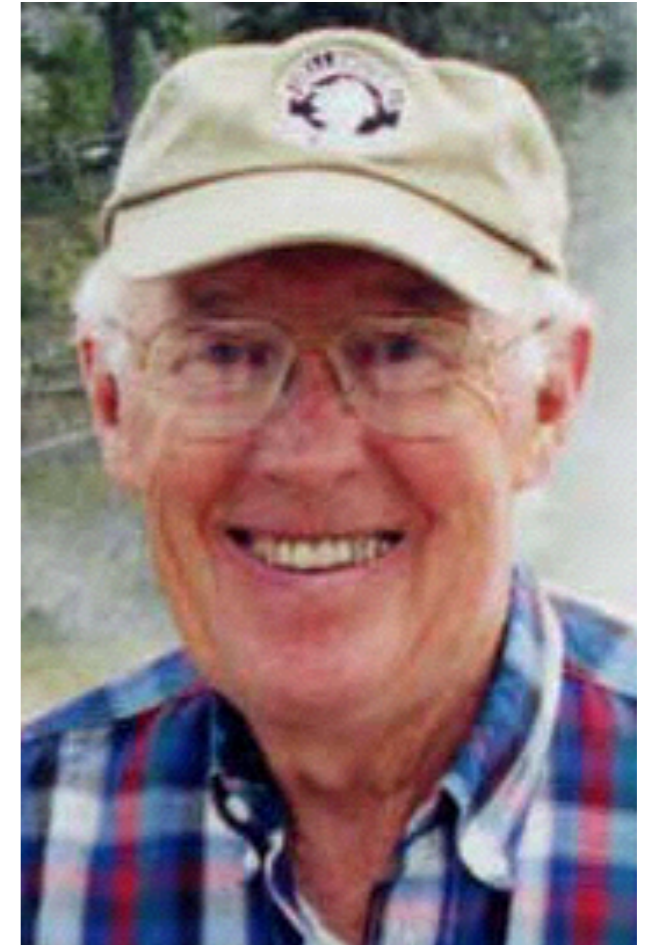
## outline

- 1) microbial ecology & environmental microbiology
- 2) ecosystem
- 3) Physical environment, Niche and biofilms
- 4) ecological role of microorganisms

# Microbial Ecology Vs Environmental Microbiology

- “**Microbial ecology** is the study of the behavior and activities of microorganisms in their natural environments.
- “microbes are small; their environments also are small.” In these small environments or “microenvironments,” other kinds of microorganisms (and macroorganisms) often also are present,.

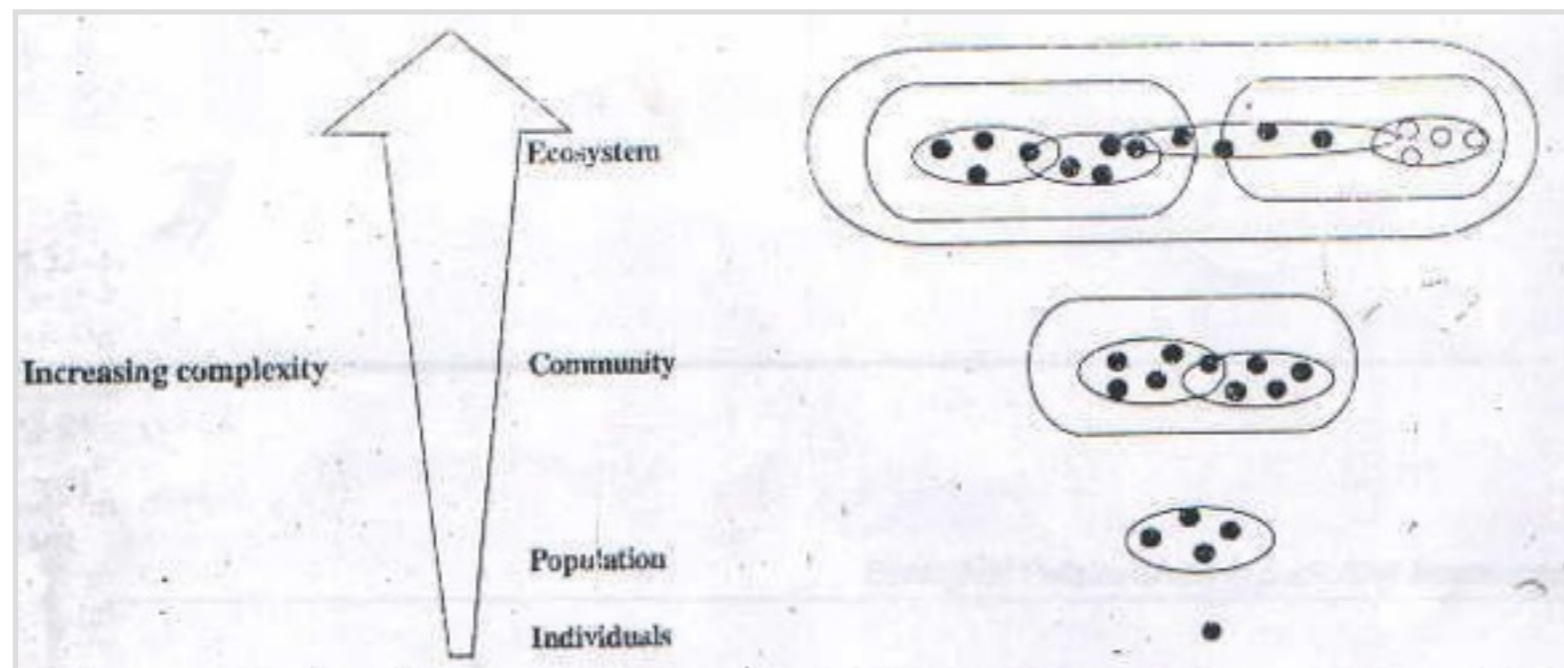
*Thomas D. Brock,*



**Environmental microbiology**, relates to all-over microbial processes that occur in a soil, water, or food, It is not concerned with the particular “microenvironment” where the microorganisms actually are functioning, but with the broader-scale effects of microbial presence and activities.

# Ecosystem

- Ecosystems have been defined as “communities of organisms and their physical and chemical environments that function as self-regulating units.” These self-regulating biological units respond to environmental changes by modifying their structure and function.
- It includes a wide range of biological, physical, and chemical processes that connect organisms and their environment.



**Figure.1 Levels of ecological organization**

# Components of ecosystem

## **1) Abiotic components**

include the non-living or physico-chemical factors like air, soil, water and the basic compounds and elements of the environment

## **2) Biotic components**

It consists of the living parts of the environment, including the association of a lot of interrelated populations that belong to different species inhabiting a common environment.

# Physical environment

- Microorganisms, as they interact with each other and with other organisms in biogeochemical cycling, are influenced by their immediate physical environment whether this might be soil, water, the deep marine environment, or a plant or animal host.

- **Microenvironment:** the specific physical location of a microorganism.

- **Niche**, includes the microorganism, its physical habitat, the time of resource use, and the resources available for microbial growth and function

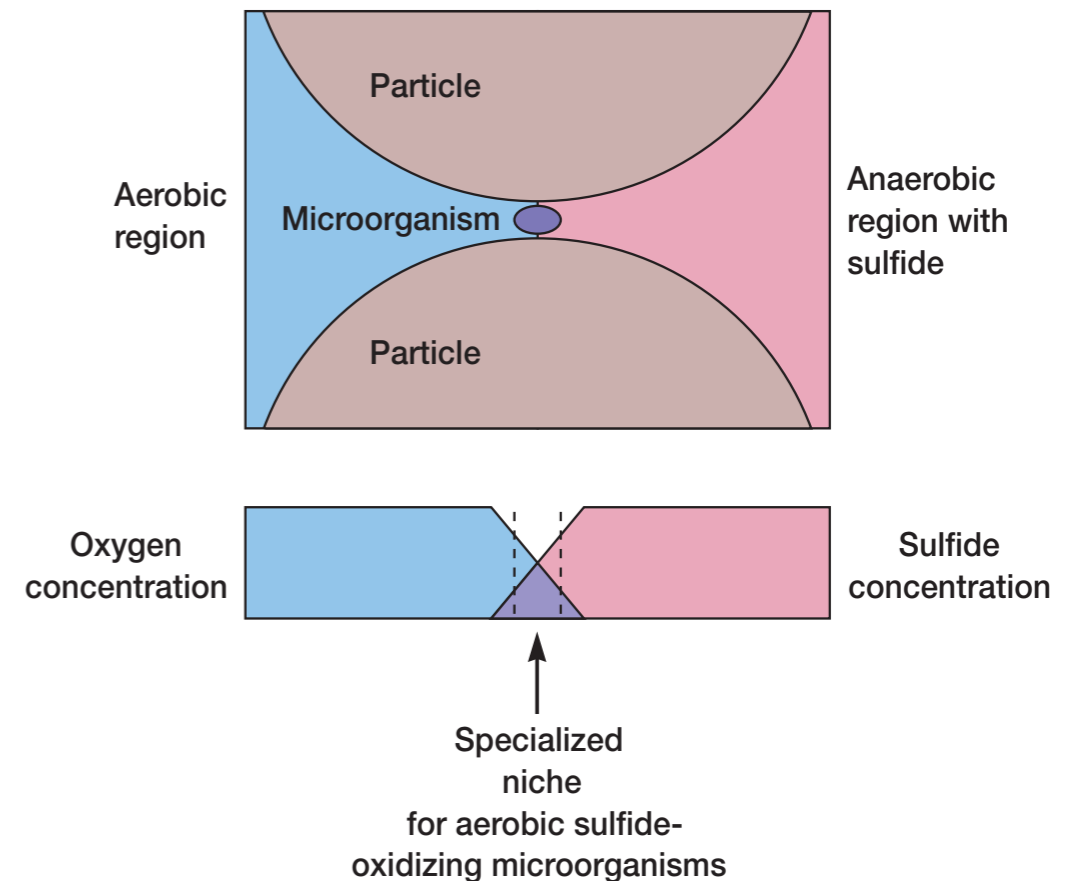
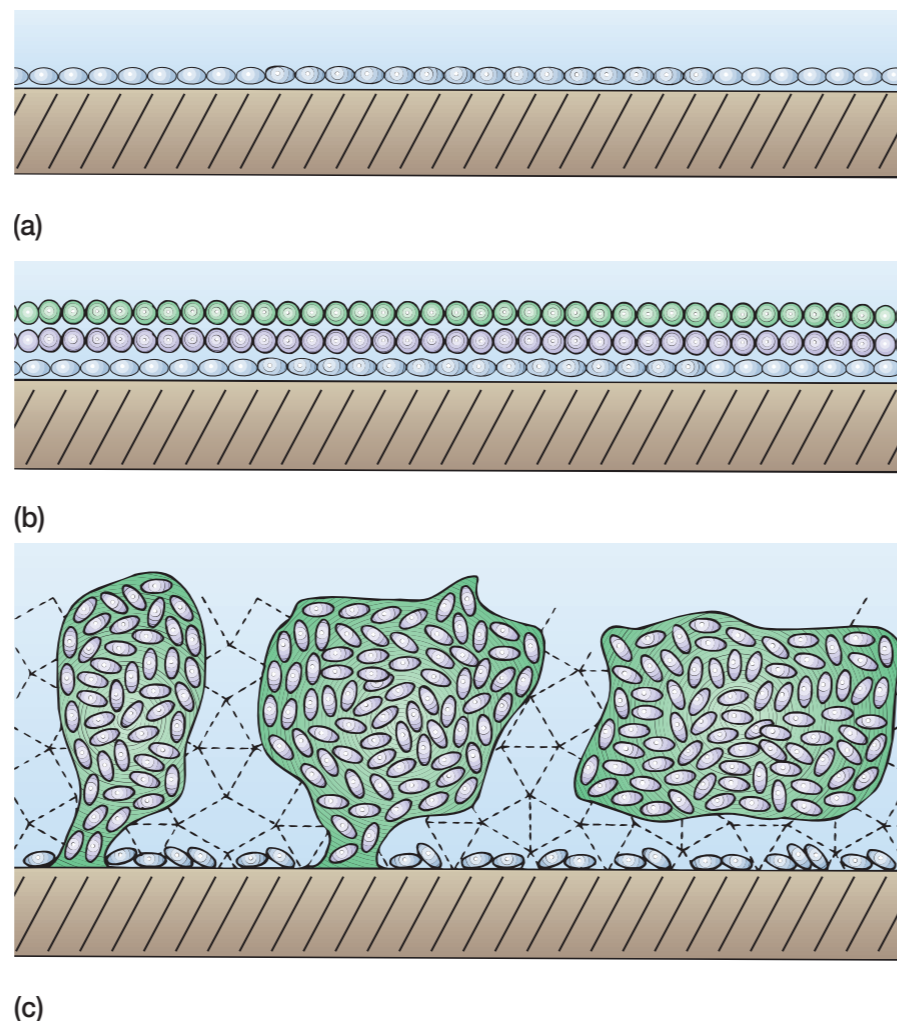


Figure2. The Creation of a Niche from a Microenvironment.

# Biofilms

Microorganisms tend to create their own microenvironments and niches, even without having a structured physical environment available, by creating **biofilms**.

**Biofilms** are organized microbial systems consisting of layers of microbial cells associated with surfaces



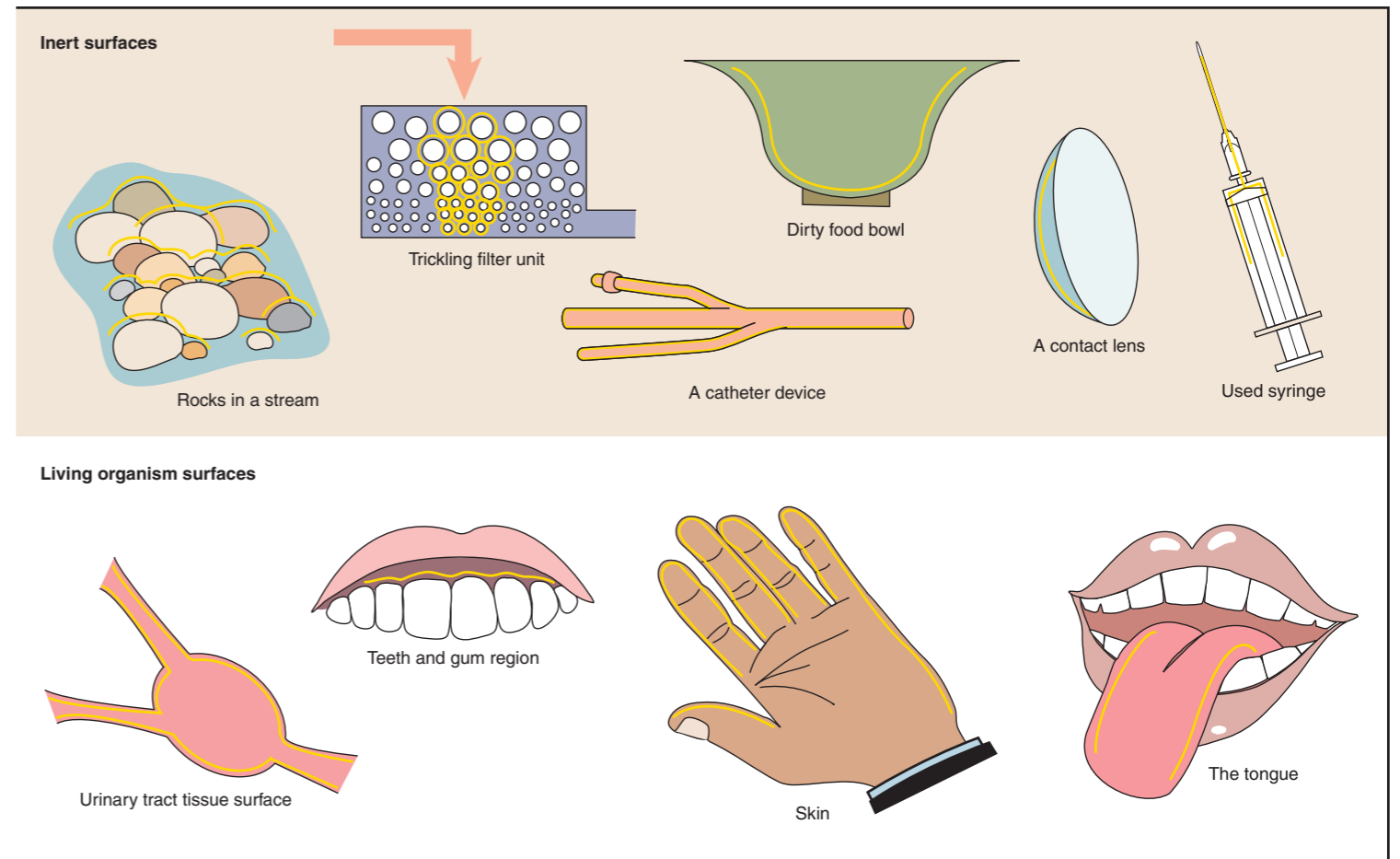
**Figure.3. The growth of biofilms.** a)Initial colonization by a single type of bacterium. b) Development of a more complex biofilm with layered microorganisms of different types. c)A mature biofilm with cell aggregates, interstitial pores, and conduits.

# Biofilms

- Protect pathogens from disinfectants, create a focus for later occurrence of disease, or release microorganisms and microbial products that may affect the immunological system of a susceptible host.

## For example:

- Air-conditioning and other water retention systems where potentially pathogenic bacteria, such as *Legionella* species, may be protected from the effects of chlorination by biofilms
- Teeth, where biofilm forms plaque that leads to tooth decay
- Contact lenses, where bacteria may produce severe eye irritation, inflammation, and infection



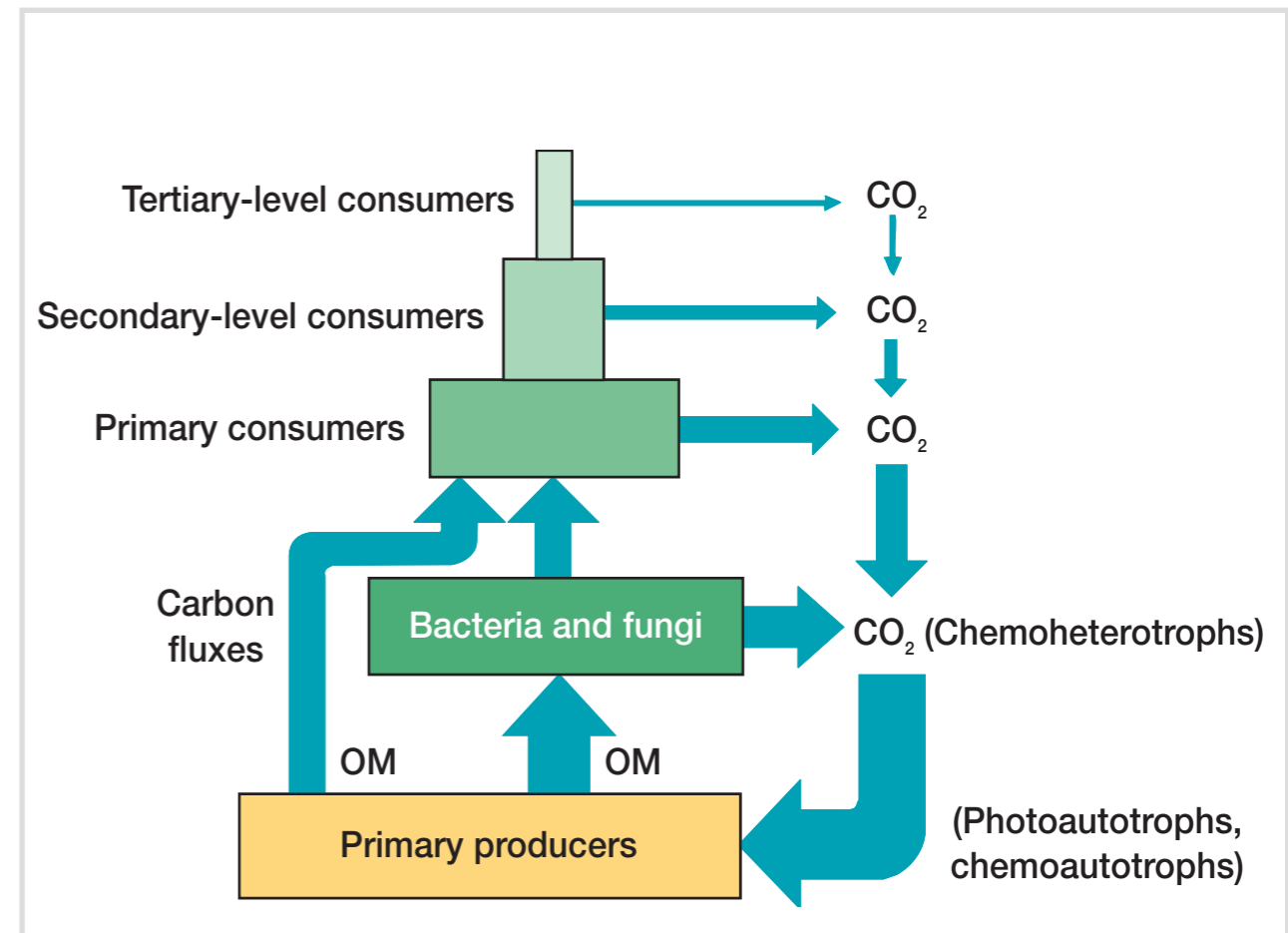
**figure.4, Biofilm Formation on living and nonliving surfaces**



# Ecological role of microorganisms

Microorganisms in ecosystems can have two complementary roles: (1) the synthesis of new organic matter from  $\text{CO}_2$  and other inorganic compounds during **primary production** and (2) de- composition of this accumulated organic matter.

- primary producers, decomposers, and primary consumers.



what are the important effects of microbial groups in nature

<b><i>Ecological role</i></b>	<b><i>Principal Microbial groups involved</i></b>
Primary producers	photoautotrophs ( microalagae&photosynthetic bacteria) Chemoautotrophs( bacteria& archaea)
<b><i>Secondary producers, assimilating dissolved organic matter</i></b>	<b><i>Bacteria, archaea, fungi, protozoa</i></b>
<b><i>a food source for consumers</i></b>	<b><i>Microalgae, cyanobacteria, bacteria, archaea, protozoa</i></b>
<b><i>important links between producers and top consumers</i></b>	<b><i>protozoa</i></b>
<b><i>Decomposing organic matter</i></b>	<b><i>Bacteria, archaea, fungi</i></b>
<b><i>biogeochemical cycling</i></b>	<b><i>All</i></b>
<b><i>structuring communities</i></b>	<b><i>Viruses, Bacteria</i></b>
<b><i>Soil formation</i></b>	<b><i>Fungi, bacteria</i></b>

**Thank you**