

Aquatic microbiology:

Microbial bio-film

Role of microbes in production of and break down of
organic matter

Microbial bio-film

- Biofilm is an assemblage of microbial cells that is irreversibly associated (not removed by gentle rinsing) with a surface and enclosed in a matrix of primarily polysaccharide material.
- **When do microbes decide to form biofilms?**
 - Mainly when they are capable of recognition of specific or non-specific attachment sites on a surface.
 - Nutritional cues.
 - Exposure of planktonic cells to sub-inhibitory concentrations of antibiotics.

- **Role of physiochemical properties of a surface:**
 - Microbes attach more rapidly to teflon and other plastics than to glass or metals.
- **Conditioning films:**
 - Formed when a material surface is exposed in aqueous medium and becomes conditioned or coated by polymers from that medium, the resulting modification will affect the rate and extent of microbial attachment.
- **Hydrodynamics:**
 - The flow velocity immediately adjacent to the substratum/liquid interface is negligible. higher velocities would be expected to equate to more rapid attachment or association to the surface, atleast until velocities become high enough to exert substantial shear forces on the attaching cells, resulting in detachment of these cells.

CHARACTERISTICS OF A SURFACE

Liquid surface

Solid surface

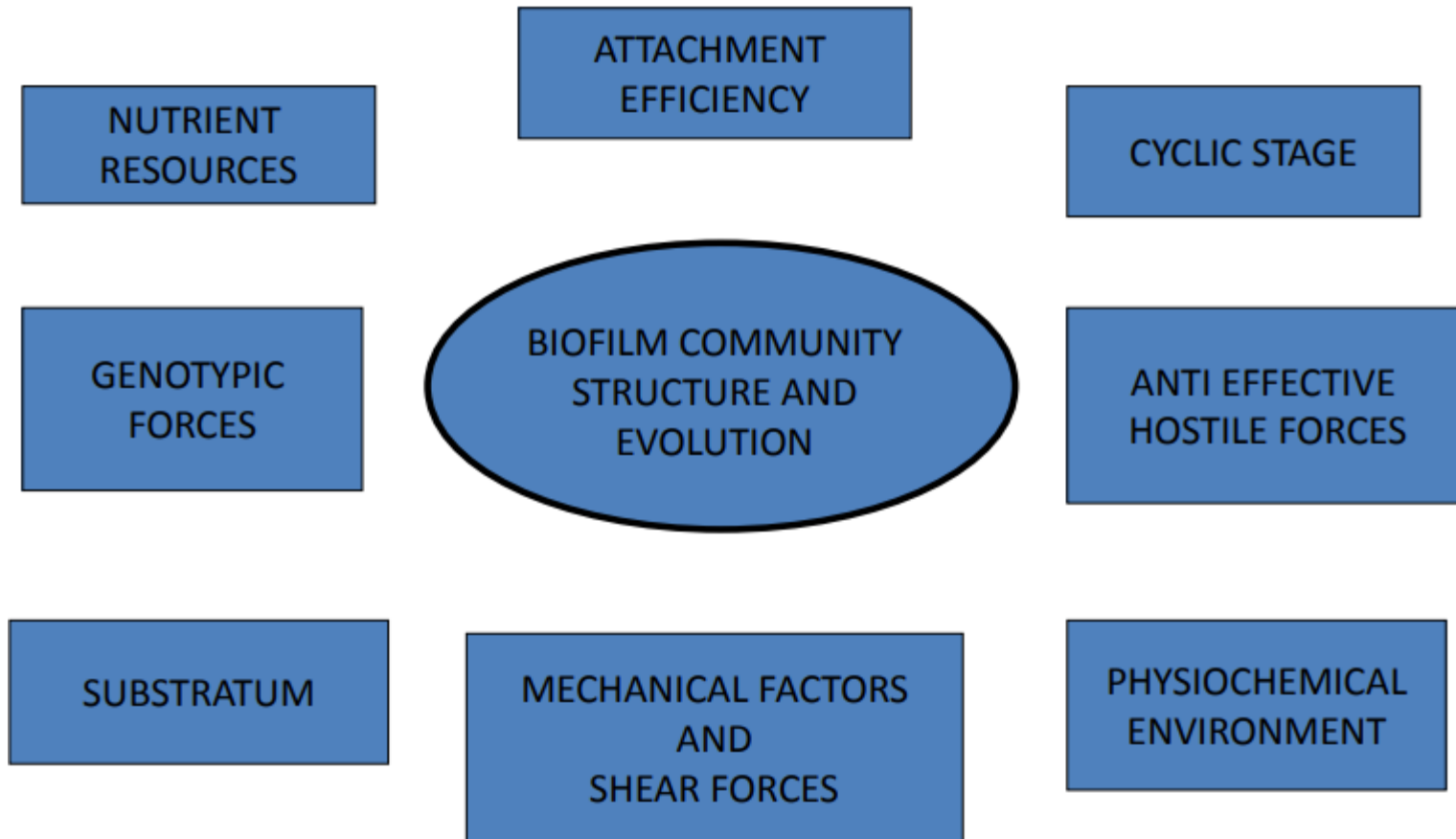
Living surface:

Leaves, wounds,
Post surgical sites,
Marine invertebrates, etc

Non living surface:

Industrial setting,
Hospital setting,
Indwelling medical devices,
Rocks/boats in sea,
Toothbrush etc

ENVIRONMENTAL AND CULTURAL FACTORS AFFECTING BIOFILM



- **Characteristics of the aqueous medium:**
- seasonal effect on bacterial attachment – depends on water temperature.
- increase in concentration of cations affects attachment presumably by reducing the repulsive forces between the negatively charged bacterial cells & surfaces like glass.
- Also it was seen that an increase in nutrient concentration correlated with increase in the number of attached bacterial cells.

STEPS IN THE FORMATION OF BIOFILM

- STEP 1:** Initial / reversible attachment -
binding of 1st colonists
- STEP 2:** Irreversible attachment –
they anchor themselves permanently using pili
- STEP 3:** Maturation 1 –
inter-communication through quorum sensing
- STEP 4:** Maturation 2 / Development –
final stage of modification
- STEP 5:** Dispersion –
essential stage for biofilm dispersion and life-cycle

Role of microbes in production and breakdown of organic matter

- Decomposition and photosynthesis are the two important process of an ecosystem.
- Microorganisms depending on substrate specificity colonize the organic matter and decompose it.
- However, the organic matter serves two functions for microflora.
- Firstly, it provides energy for growth and secondly it provides carbon source for the formation of new cells.
- During this process, certain waste products are also produced by microorganisms e.g. organic acids, carbon-dioxide, methane, etc.

- The process of conversion of substrate to protoplasmic carbon is known as assimilation.
- About 20-40% substrate is assimilated and rest is released as carbon-dioxide or accumulated as waste.
- When the carbon assimilation occurs, the other inorganic chemicals such as nitrogen, phosphorus, potassium and sulphur are also taken up for the formation of new cells.
- By this process, microorganisms accumulate inorganic substances in their cells and reduce the concentration of nutrients for plants in soil.
- This event of accumulation of inorganic substance by the microorganisms and making the plants, nutrient-deficient is known as immobilization.

- Microorganisms of different groups colonize the substrate depending upon its chemical composition.
- Thus microbial succession occurs on the decomposing material till it fully disappears in elemental forms.
- The events of sequential appearance of microorganisms on a substrate with respect to time are called succession.