Environmental microbiology

is the science that deals with studying the relationship between microorganisms and their non-living environment (soil, water, and air) and their living environment (humans, animals, and plants) and the effect of physical factors (heat, humidity, radiation, pressure, lightening) and chemical factors (salinity, pH, toxic substances, Heavy metals, antibiotics, and biotic agents (predators).

Microbial Community : A group of microbes that live in a specific environmental location and belong to different species, such as microbial groups found in the coastal sediments of ponds and lakes.

Microbial population : A group of microbes that live in a specific environmental location and belong to the same species, such as a pure culture of E. coli bacteria

Microbial Ecosystems

microbial communities can live in a specific environment and interact with it in order to maintain a stable system that includes the circulation of energy and the exchange of elements between microbes and their living and non-living environment.

Natural ecosystem:

1-Aquatic ecosystem: Lakes,rivers,swamps,sea and oceans

2- Terrestrial ecosystem: Soil and Rocks on earth cortex.

3- **Aerial ecosystem**: atmosphere surrounding the Earth

4- **Biological Ecosystem**: Such as the human intestines, oral cavity, the nasal cavity in humans, and the intestines of ruminants .

Anthropogenic Ecosystem

1- Wastewater decomposition tanks.

2- microbial culture media.

3- Bioreactors : to produce biomass in the field of biotechnology to produce hormones and enzymes

The ecosystem may be large or it may be small. For example, a pond or lake is a large ecosystem, but the organic particles suspended in it are a delicate ecosystem. In biological systems, the nasal cavity, oral cavity, or intestine are considered microenvironments.

Microbes can be classified according to the environment in which they :live

1- **specialized microbes**: they are found in a specific environmental location and their numbers are low but stable. Such as the bacterium ***Treponema palladium***, which lives in the human genital areas and causes syphilis and cannot be found anywhere else.

2- **Non specialized Microbes**: they live in different environments, in more than one environmental location. they are characterized by their ability to reproduce rapidly and their numbers increase when environmental conditions are suitable. For example, the root nodule bacteria ***Rhizobium meliloti*** are found in the soil and in the root nodules of leguminous plants, as well as the methane ***Methanobrevibacter smithii*** bacteria, which are found in lake sediments and in the rumen of ruminants

The poorest microbial ecosystem is the aerial ecosystem, which is an unsuitable system for the growth and reproduction of microbes due to:

1- ultraviolet rays that are deadly to microbes:

2-drought, wind, and lack of nutrients. In contrast to (fertile soil), which contains animal corpses and plant remains fall into it,

-- the aquatic environment is also considered an ideal environment in addition to the intestinal environment in humans and the rumen of ruminants.

The borders of ecosystems, such as soil and water are clear, while the borders of microbial ecosystems are unclear due to a single environmental activity carried out by several microbial species, such as decomposing organic waste

Eurioecious : are wide-ranging microbes that are active in various ecosystems, such as **Pseudomonas** and **Bacillus** bacteria. We find them in soil, water, and living organisms.

---The Russian environmental microbiologist **Winogradsky (1925)** defined the microbial community into two groups:

1 -**Autochthonous microbial community**: A group of microbe that always present in the environmental site and not from an external source, and continue to grow even if new materials are added to the ecosystem, such as fertilizers, organic materials, pollutants. Such as **Bacillus** bacteria found in soil, **Pseudomonas** in water, and E. coli bacteria in the intestines

2 - **Allochthonous microbial community**: microbes coming from an external environment to a new environmental site and become active due to additions to the environmental site, but their growth stops or die when the added materials are removed, such as sweage fungi, which are filamentous bacteria such as ***Sphaerotilus natans*** and ***Beggiatoa alba***, which grow and increase in number at point where polluted water flows meet with the river where presence of organic matter that bacteria decompose it

and then gradually disappear with river flow as a result of the decomposition of organic matter .also bacteria coming from human waste.

--In soil and water environments, it is difficult to distinguish allochthonous microbe from a autochthonous microbe because most microbes have the ability to adapt, settle, reproduce, and interact in different environments. There are three conditions that determine the original microbe:

1 - When isolation is repeated periodically from the same habitat for a long period, the same microbial population appears in high ratio

2 - The isolated microbial population consumes the same nutrients in the same habitat

3- Isolating microbes that resistant extreme conditions