

Definitions of Environmental Microbiology

The roots of environmental microbiology are most closely to the microbial ecology, which comprises (تشمل) the study of the interaction of microorganism within the environment (air, water or soil).

Microbial ecology:

The study relationship (علاقة) of microorganisms with one another and with their environment.

It concerns the three major domains of life -Eukaryota, Archaea, and Bacteria -as well as viruses.

Environmental microbiology

The study of the composition and physiology of microbial communities in the environment.

The environment in this case means the soil, water, air and sediments covering the planet and can also include the animals and plants that inhabit these areas.

Environmental microbiology also includes the study of microorganisms that exist in artificial environments (البيئة الصناعية) such as bioreactors.

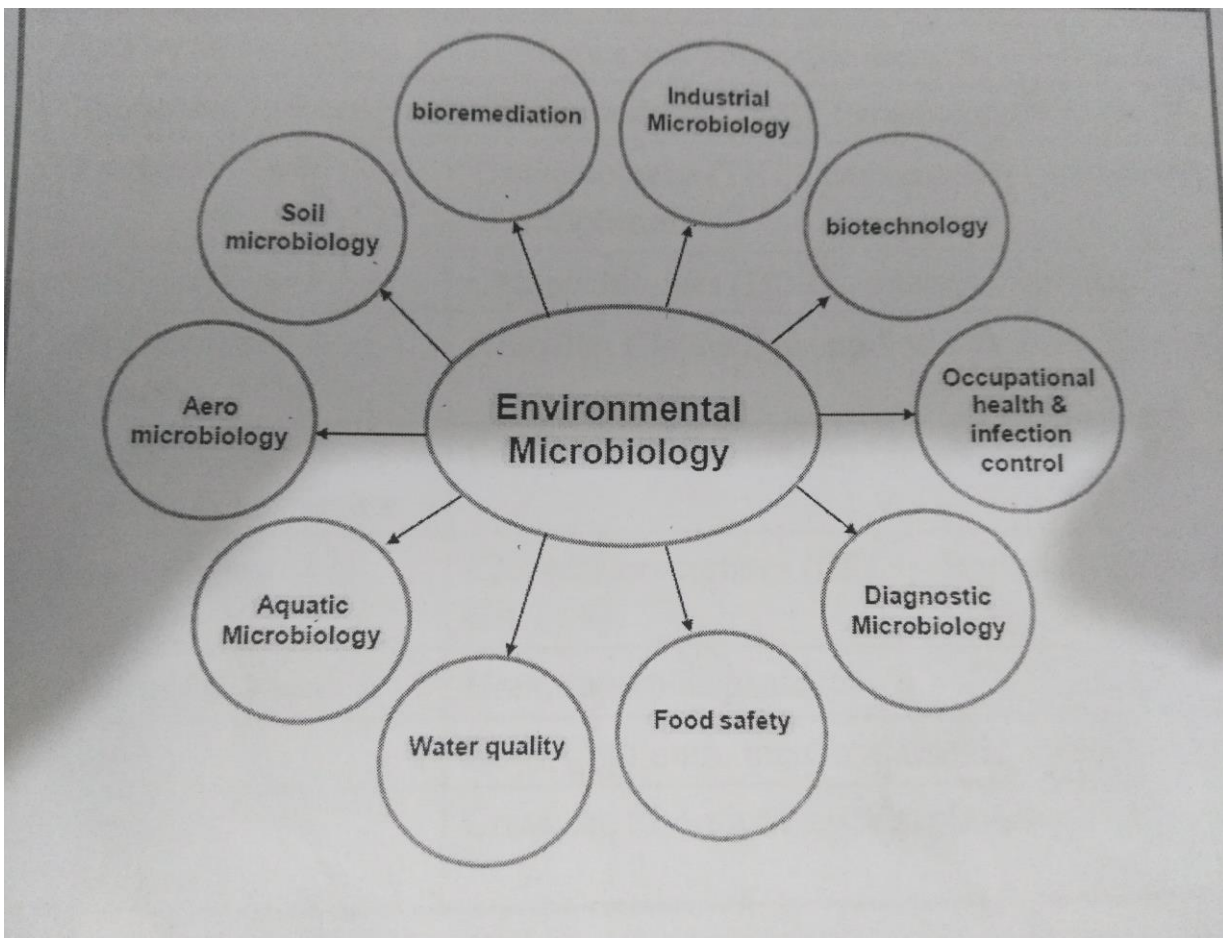


Figure 1. The Related Fieldes Branched from Environmental Microbiology

The need to understand environmental microbiology:

1. The emergence (ظهور) of a series of new waterborne and food-borne pathogens that posed a threat (تهديد) to human and animal health.
2. The past waste disposal practices contaminate the surface and groundwater with organic and inorganic chemicals.
3. The discovery of the structural DNA engaged the development of new technologies (Polymerase Chain Reaction PCR) for measuring and analyzing microbes.

These together caused the scientists to question the notion (مفهوم) that our food and water supplies are safe and also allowed the development of tools to increase the ability to detect (كشف) and identify تحديد microbes and their activities in the environment.

Table 1. Some common water born disease (الامراض التي تنتقل عن طريق المياه) and water related disease.

Disease	Morbidity (episodes/yr.) (or as stated)	Mortality (deaths/yr.)	Relationship of Disease to Water Supply and Sanitation
Diarrheal diseases الإسهال	1,000,000,000	3,300,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Infection with intestinal helminthes	1,500,000,000	100,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene.
Schistosomiasis البilharسيا	200,000,000	200,000	Strongly related to unsanitary excreta disposal and absence of nearby sources of safe water
Malaria المالاريا	400,000,000	1,500,000	Related to poor water management, water storage, operation of water points and drainage
Poliomyelitis شلل الأطفال	114,000	-	Related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Trachoma الرمم	150,000,000	-	Strongly related to lack of face washing, often due to absence of nearby sources of safe water
Dengue Fever حمى الضنك	1,750,000	20,000	Related to poor solid wastes management, water storage, operation of water points and drainage

Q. List the common water-related diseases, the mention the relationship of disease to water supply and sanitation

Classification of Environment:

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1. Physical or abiotic environment: the external factors like air, water & soil (land).
2. Living or biotic environment: all living organisms around us like plants, animals & microorganisms.

Components of Ecosystem (Environment):

A. abiotic components: which also consist of:

- I. Climatic factors: like temperature, light level & water.
- II. Soil factors: like mineral matter, texture, organic matter & organisms.

B. Biotic components: which consist of:

- I. Producers المنتجون (autotrophs or self-feeders): like green plants that having chlorophyll.
- II. Consumers المستهلكون (heterotrophs): like all living organisms do not have chlorophyll, for example cow, rabbit, snake, tiger, lion etc.
- III. Decomposers (saprotrophs): mainly include bacteria & fungi (which live on the dead organic matter).

Some important terms in Environmental Microbiology:

- ★ **Abiotic environment:** non-living components of ecosystems, including physical & chemical factors. Examples: temperature, light level, rainfall etc.
- ★ **Acclimation** التماقلم: a gradual physiological adaptation of the living organism to the environmental changes.
- ★ **Aerobic:** relate to the respiration & metabolism in the presence of oxygen.
- ★ **Anaerobic:** relate to the respiration & metabolism without oxygen.
- ★ **Autotroph:** living organism capable of photosynthesis (produce organic molecules "sugar" from inorganic molecules " CO_2 & H_2O ", depend on itself for food stuff "or self-dependent in nourishment").

- ★ **Biogeochemical cycles:** the natural cycles of the elements & components from which the inorganic compounds turn to organic one & the vice versa.
- ★ **Biotic factors:** environmental factors resulted from the living organism's activity.
- ★ **Consumer:** the organism which feed on the other organisms.
- ★ **Decomposer:** living organism obtain its food through break down of complex organic compounds into simpler inorganic compounds.
- ★ **Food chain:** the transfer of energy (food) from one organism to another each of which occupies (تحتل) a specific trophic level.
- ★ **Habitat:** physical part of the environment where the organism lives.
- ★ **Heterotrophs:** the organism incapable of photosynthesis & depend on the other organisms to obtain its food supply.
- ★ **Lentic:** the ecology of standing water, e.g. Lakes, ponds, etc.
- ★ **Lotic:** the ecology of running water, e.g. Rivers, streams, etc.
- ★ **Productivity:** the amount of energy stored in the living body of an organism in specific area & time.

Microorganism: the organism of microscopic or submicroscopic size, especially bacteria or viruses.

- A. Bacteria:** unicellular; prokaryotes; widely occurring microbes that are often important in recycling of materials in the environment. Many bacteria cause disease; while others are useful.
- B. Fungi:** unicellular or multicellular eukaryotes include yeasts; molds; mushrooms; cup fungi and lichens. Fungi are widespread and important recyclers in the environment and some of them produce commercially important products such as antibiotics and alcohols. Some are pathogenic and cause disease.
- C. Algae:** they are occurring in a variety of forms including unicellular; colonial; filamentous micro-algae and large multicellular macro-algae. They are photosynthetic organisms that are responsible for production of organic molecules in the aquatic environments. They have several groups including: Diatoms (Crysophyta); Dinoflagellates (Pyrrophyta); Euglenoids (Euglenophyta); Green algae (Chlorophyta); Brown algae (Phaeophyta) and Red algae (Rodophyta).

D. Protozoa: unicellular; non-photosynthetic organisms and widespread in aquatic environments and wet soils (الترب الرطبة). The important trait for classification of these organisms is the organelle used for motility. Protozoans have *pseudopodia*; *cilia* or *flagella* and some of them *do not have any of these structures*.

Some microbiological important terms:

- ★ **Microbicide** (قاتل للميكروبات): a chemical that kills microbial cells and spores. Include (bactericide, fungicide, algaecide, insecticide, etc.).
- ★ **Microbistatic** (مثبط للميكروبات): a chemical that inhibits microbial growth.
- ★ **Disinfection** (المطهرات): destroy only the vegetative forms but not spores. Used only for inanimate objects because the effective concentration can be toxic to human tissues.
- ★ **Antiseptics** (المعقمات او المطهرات): destroy or inhibit microorganism on the skin and other tissues.
- ★ **Infection:** entry → establishment (انشاء المستعمرات) → multiplication of pathogens within the host.