

Extremophiles

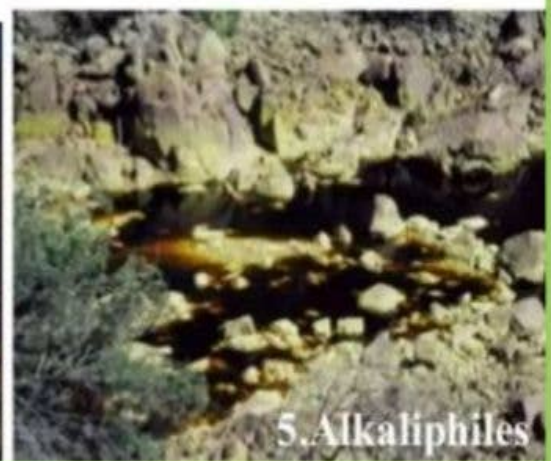
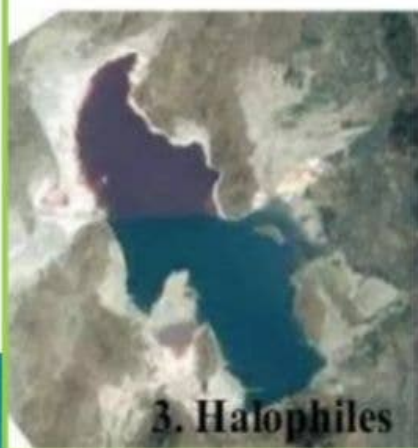
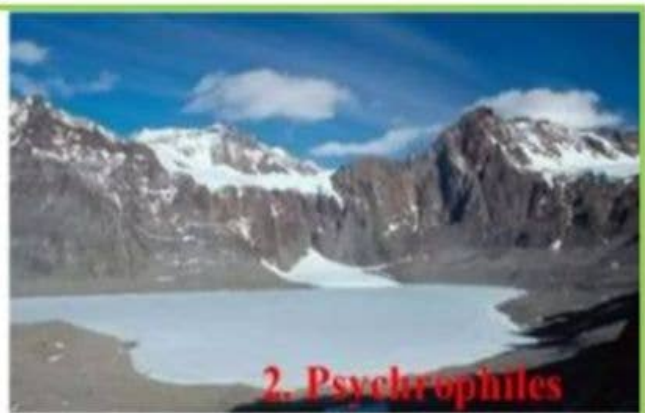
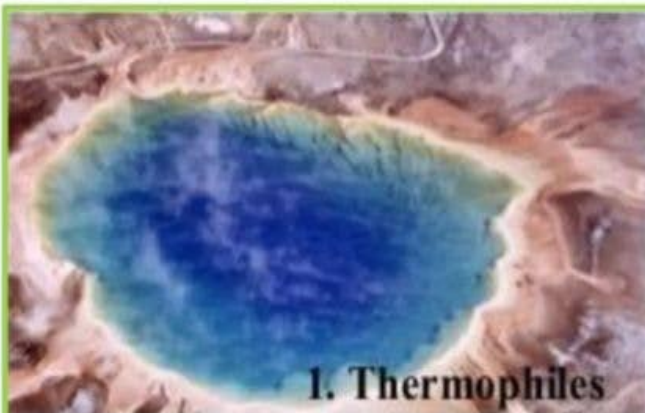
Microbes in extreme environment

Introduction

- ▶ Micro- organisms are small living organisms. We can't see them without a microscope.
- ▶ They are different shape and size.
- ▶ They are found every where.
- ▶ Microbes are useful or harmful for us.
- ▶ Some microbes lives in extreme harsh condition known as extremophiles.



Microbes in extreme environment



Microbiology of extreme environment

- temperature
- pH
- humidity/water
- salinity
- sugar
- pressure
- rocks
- heavy metals
- radiations



Extremophiles

- ▶ These are micro-organisms lives in extreme condition. They include:
- ▶ Thermophiles
- ▶ Halophiles
- ▶ Pschrophiles
- ▶ Barophiles
- ▶ Xerophiles
- ▶ Acidophiles
- ▶ Mathenogenic

▶

Thermophile

- ▶ A **thermophile** is an organism—a type of extremophile—that thrives at relatively high temperatures, between 41 and 122 °C (106 and 252 °F). Many thermophiles are archaea.
- ▶ Thermophiles are found in various geothermally heated regions of the Earth, such as hot springs like those in Yellowstone National Park and deep sea hydrothermal vents.
- ▶ Thermophiles can survive at high temperatures, whereas other bacteria would be damaged and sometimes killed if exposed to the same temperatures.
- ▶ Thermophiles can be classified according to their optimal growth temperatures:
 - ▶ Simple thermophiles 50–64 °C
 - ▶ Extreme thermophiles 65–79 °C
 - ▶ Hyperthermophiles 80 °C, but not < 50 °C.

Halophiles

- ▶ The halophiles, means "salt-loving", are extremophiles that thrive in high salt concentrations.
- ▶ While most halophiles are classified into the domain Archaea, there are also bacterial halophiles and some eukaryotic species.
- ▶ Halophiles can be found in water bodies with salt concentration more than five times greater than that of the ocean.
- ▶ Halophiles are categorized by the extent of their halotolerance: slight, moderate, or extreme.
- ▶ Slight halophiles prefer 0.3 to 0.8 M, moderate halophiles 0.8 to 3.4 M, and extreme halophiles 3.4 to 5.1 M salt content.
- ▶ Halophiles require sodium chloride (salt) for growth, in contrast to halotolerant organisms, which do not require salt but can grow under saline conditions.

Methanogens

- ▶ These are lives in anaerobic condition.
- ▶ They are widely distributed in nature such as deep sea water, sewage area and stomach cow.
- ▶ These are helpful to the ruminants for fermentation of cellulose.
- ▶ Methanogens obtain their energy from the use of carbon dioxide and hydrogen gas. They are autotrophs.
- ▶ These are obligate anaerobes.

Psychrophiles

- ▶ **Psychrophiles** or **cryophiles** are extremophilic organisms that are capable of growth and reproduction in low temperatures, ranging from -20°C to $+10^{\circ}\text{C}$.
- ▶ They are found in places that are permanently cold, such as the polar regions and the deep sea.
- ▶ Psychrophile is Greek for 'cold-loving'.
- ▶ Many such organisms are bacteria or archaea, but some eukaryotes such as lichens, snow algae, fungi are also classified as psychrophiles.
- ▶ They are present in permafrost, polar ice, glaciers, snowfields and deep ocean waters.
- ▶ These organisms can also be found in pockets of sea ice with high salinity content.

Barophiles

- ▶ A barophile is an organism that needs a high-pressure environment in order to grow.
 - ▶ Barophiles are a type of an extremophile.
 - ▶ An example of a high-pressure habitat is the deep-sea environment, such as ocean floors and deep lakes where the pressure can exceed 380 atm.
 - ▶ Barophiles that cannot survive outside their high-pressure habitats are referred to as *obligate barophiles*.
 - ▶ Those that can live at high pressures and in less extreme environment are referred to as *barotolerants*.
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- ▶ Many barophiles are sensitive to ultraviolet rays and are susceptible to UV radiation.
- ▶ They lack the essential mechanisms of DNA repair to counter the effects of UV radiation.
- ▶ Thus, many of them grow in darkness. Because of this, they also tend to be psychrophilic. That means they live under cold temperatures, e.g. about 2-3 °C below 100 m.
- ▶ *Halomonas salaria*, a Gram-negative proteobacterium, is an example of an obligate barophile. It needs a pressure of 1000 atm.
- ▶ Another example of barophile is the Xenophyophores, which are single-celled eukaryotes found in the deepest ocean area.

Xerophiles

- ▶ Xerophiles are extremophilic organisms that can grow and reproduce in conditions with a low availability of water, also known as water activity.
- ▶ Water activity is a measure of the amount of water within a substrate that an organism can use to support sexual growth.
- ▶ Xerophiles are "xerotolerant", meaning tolerant of dry conditions.
- ▶ The common food preservation method of reducing water activities may not prevent the growth of xerophilic organisms, often resulting in food spoilage.
- ▶ Some mold and yeast species are xerophilic. Mold growth on bread is an example of food spoilage by xerophilic organisms.
- ▶ Examples of xerophiles include *Trichosporonoides nigrescens* and cacti.

Acidophiles

- ▶ Acidophiles or acidophilic organisms are those that thrive under highly acidic conditions (usually at pH 2.0 or below).
- ▶ These organisms can be found in different branches of the tree of life, including Archaea, Bacteria, and Eukarya.

Example:

- ▶ *Sulfolobus*
- ▶ *Thiobacillus*
- ▶ *Mucor racemosus*