EFFECT OF PHYSICAL FACTORS ON MICROORGANISMS

“ 240 MIC ”

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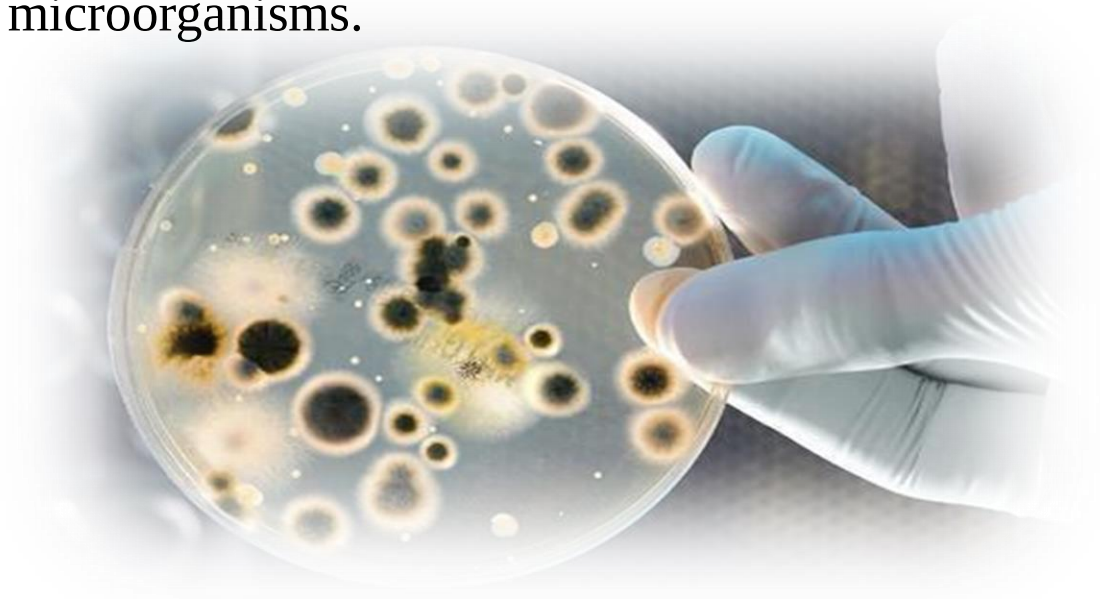
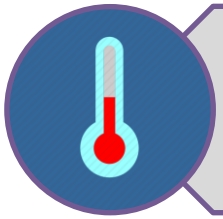
The growth of microorganisms is greatly affected by the **chemical** and **physical** nature of their environment.

An understanding of the environmental factors that promote microbial growth aids in understanding the ecological distribution of microorganisms.

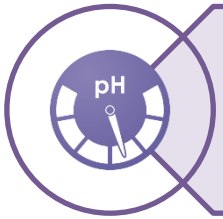
These same environmental factors that maximize microbial growth can also be manipulated to inhibit or retard the growth of unwanted microorganisms.



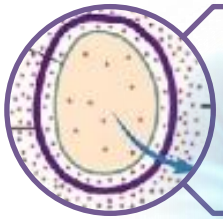
EFFECT OF PHYSICAL FACTORS ON MICROORGANISMS



Temperature



pH



Osmotic pressure

TEMPERATURE

Each microbial species requires a **temperature growth range** that is determined by the heat sensitivity of its particular enzymes, membranes, ribosomes, and other components. As a consequence, microbial growth has a fairly characteristic temperature dependence with distinct **cardinal temperatures:**

Minimum, Maximum, and Optimum.

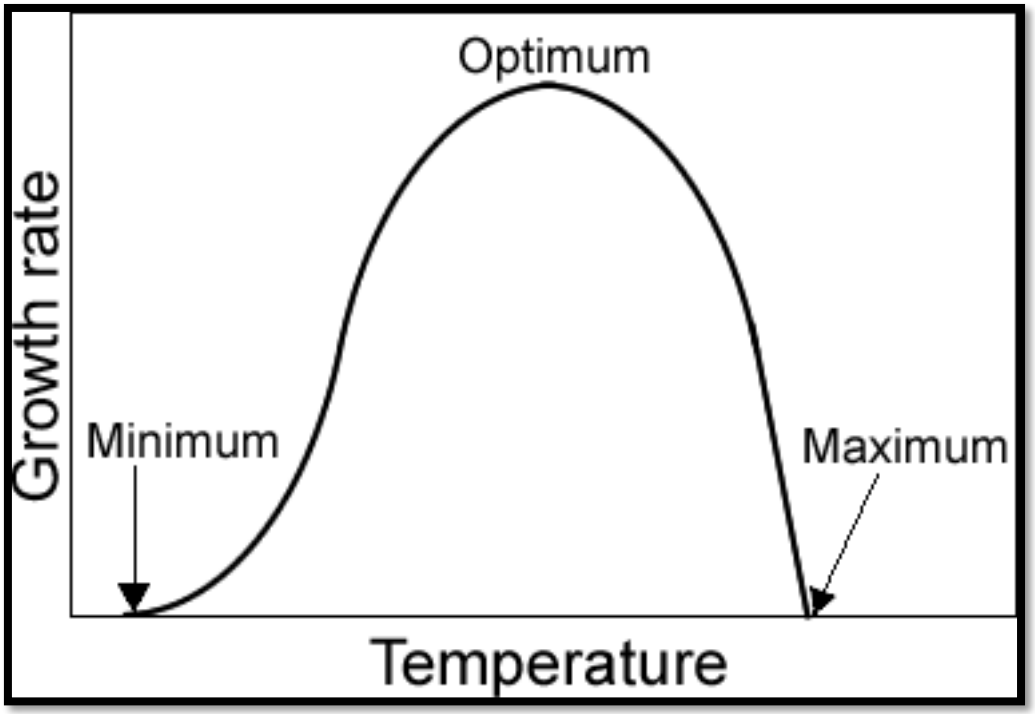
Minimum growth temperature
is the lowest temperature at which growth will occur.

Maximum growth temperature
is the highest temperature at which growth will occur.

Optimum growth temperature
is the temperature at which the rate of cellular reproduction is most rapid.

The **optimum** temperature for the growth of a given microorganism is correlated with the temperature of the normal habitat of the microorganism.

For example, the optimum temperature for the growth of bacteria pathogenic to humans is near that of the temperature of human blood (**35° to 37°C**).



pH

The pH affects the activity of enzymes especially those that are involved in biosynthesis and growth.

Each microbial species possesses a definite pH **growth range** and a distinct pH **growth optimum.**

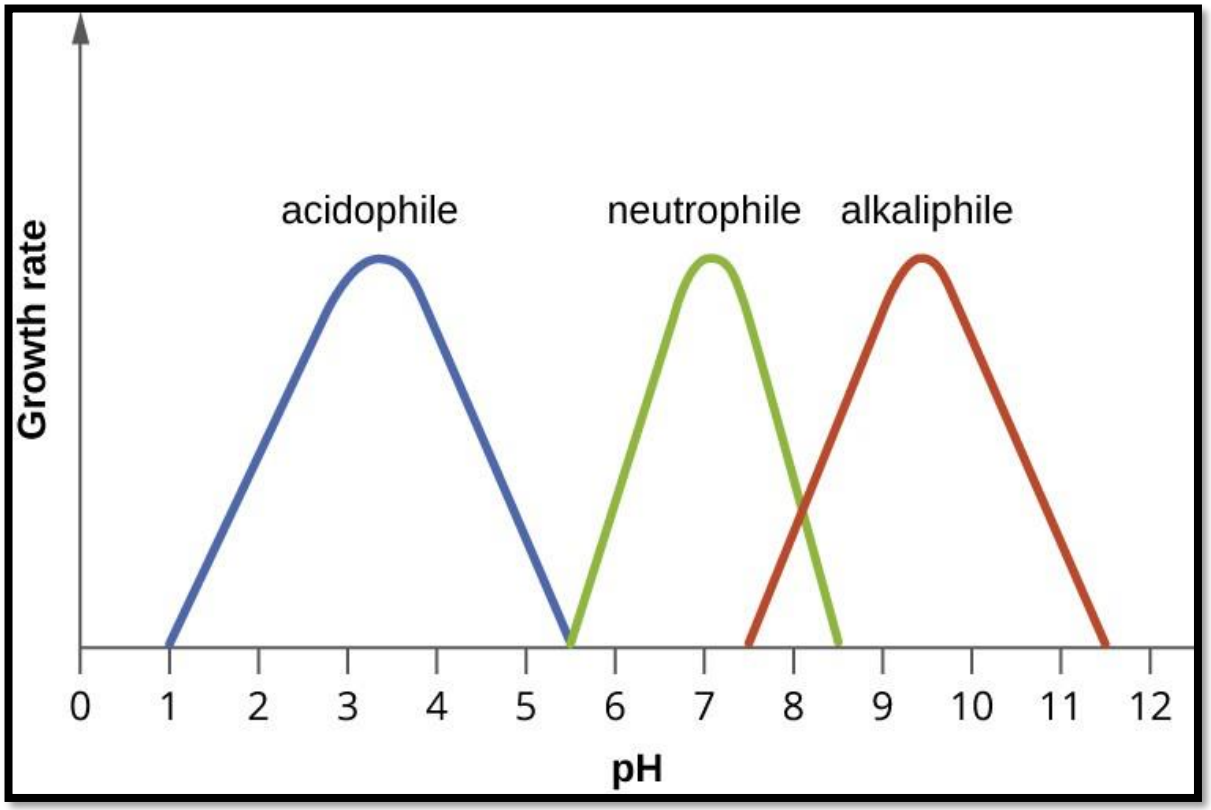
Acidophiles
have a growth optimum between pH 0.0 and 5.

Neutrophiles
have a growth optimum between 5.5 and 8.0.

Alkalophiles
have a growth optimum between 8.5 to 11.5.

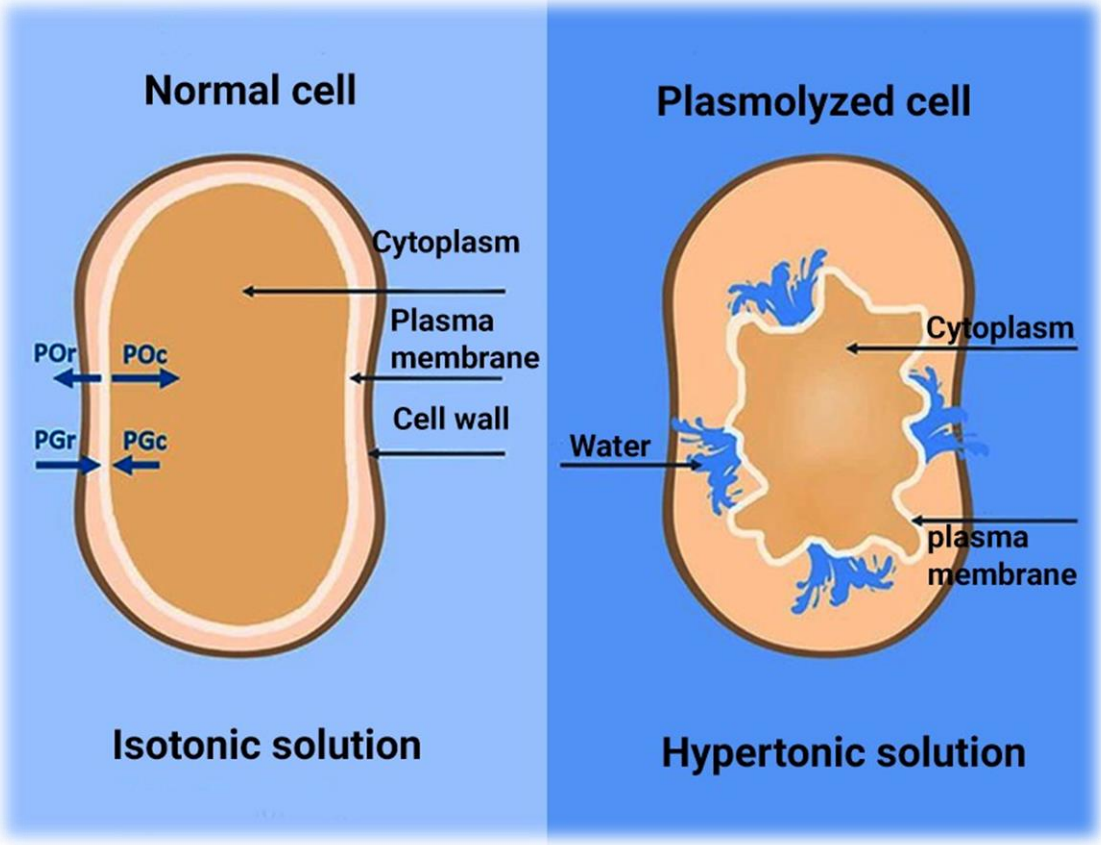
In general, different microbial groups have characteristic pH optima.

- The majority of **bacteria** and **protozoa** are **neutrophiles.**
- Most **fungi** (molds and yeasts) occupy slightly **acidic** environments in the pH range of 4 to 6.
- **Algae** also seem to favor **acidity**.



OSMOTIC PRESSURE

Since bacteria are separated from their environment by a **selectively permeable plasma membrane,** they can be affected by changes in the osmotic pressure or water availability of their surroundings.



❖ **Osmotic pressure:**

Is the force developed when two solutions of different solute **concentrations** are separated by a **membrane** that is permeable only to the solvent.

❖ **The solvent:**

Is the liquid, usually water, which dissolves a substance (**the solute**).

- ❖ **A few bacteria, called halophiles,** are able to tolerate high (hypertonic) salt concentrations.
- ❖ **Bacteria that can live in very salty environments are called extreme halophiles** to distinguish them from the **moderate halophiles** that live in the sea.

- ❖ In an **isotonic solution,** the concentration of solutes is the same (iso means equal) outside and inside the bacterium.

The bacterium is in osmotic equilibrium with its environment and does not change volume.

DEFINITIONS

Osmosis

The movement of water across a semipermeable membrane in response to differing solute concentrations on each side.

Osmotic pressure

The force developed within a cell due to movement of water across the cell membrane due to unequal solute concentrations.

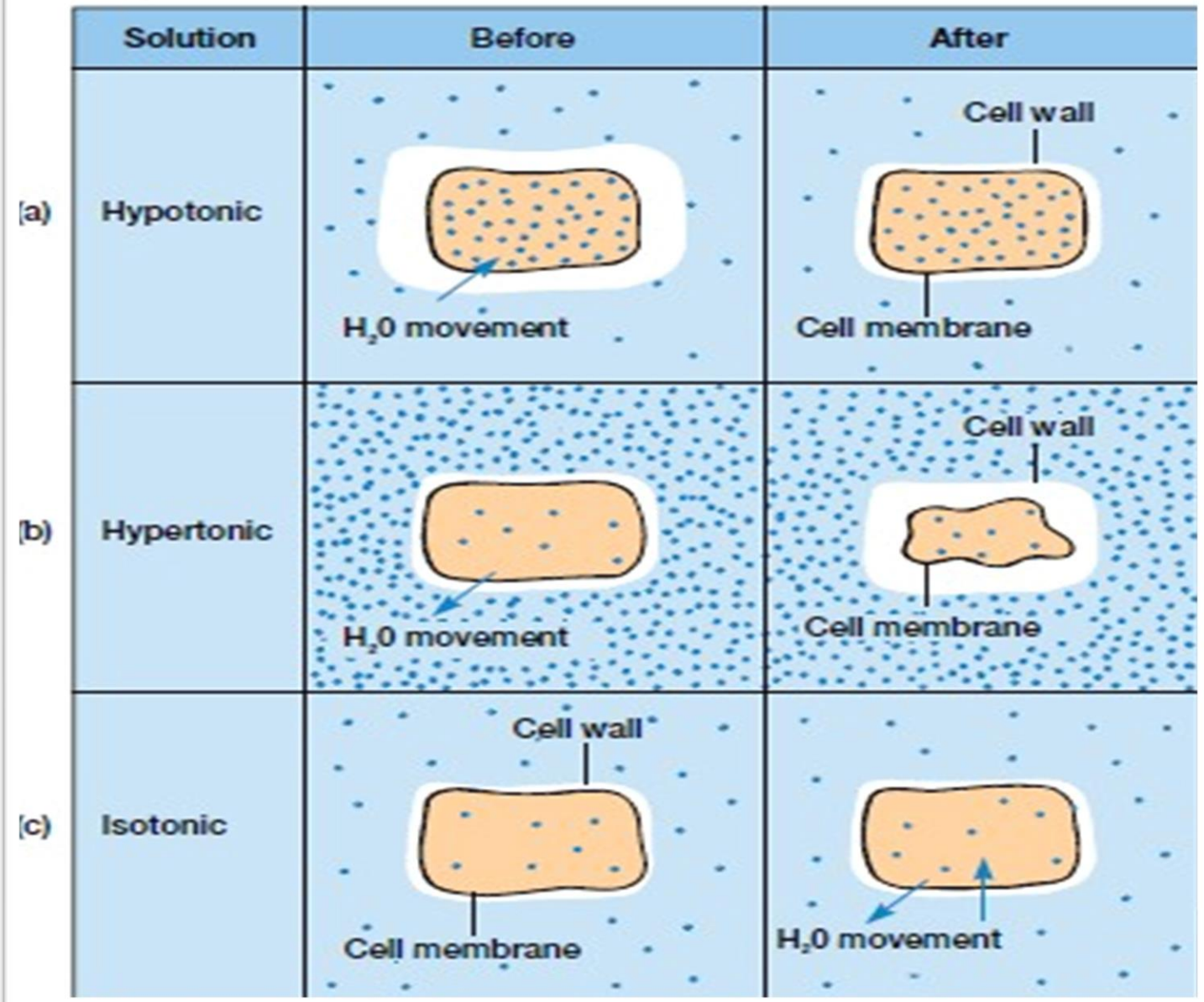
Plasmolysis

When the plasma membrane shrinks away from a microbial cell wall due to a hypertonic solution.

Halophilic

Bacteria that tolerate and grow well in hypertonic salt solutions.

Figure 41.1 Effect of Osmotic Pressure on a Bacterial Cell. The dots represent solute (NaCl) molecules. The shaded area represents water (solvent).



The End