



Effect Of Physical Factors On Microorganisms

Lab 8

Effect Of Physical Factors On Microorganisms

- **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 help in understanding the ecological distribution of microorganisms.**
- **These same environmental factors that maximize microbial growth can also be manipulated to inhibit or slowdown the growth of unwanted microorganisms.**
- Some of these factors include:
 - 1. Temperature**
 - 2. pH**
 - 3. Osmotic pressure**

1-Temperature

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

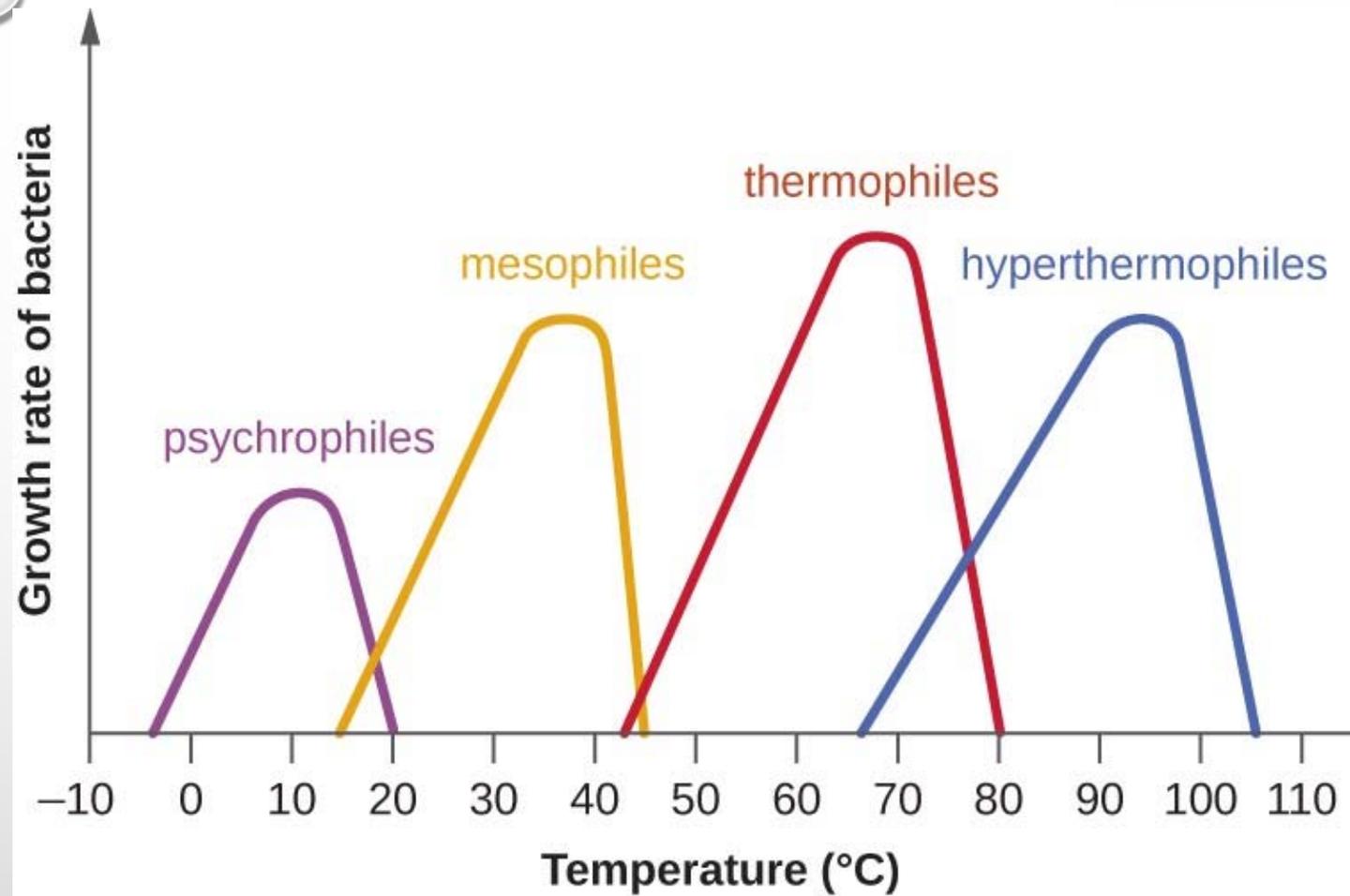
Minimum growth temperature: is the **lowest temperature** at which growth will occur

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**.

Temperature

- 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)**.



The graph shows growth rate of bacteria as a function of temperature.

Notice that the curves are **skewed toward the optimum temperature.**

The skewing of the growth curve is thought to reflect the rapid denaturation of proteins as the temperature rises past the optimum for growth of the microorganism.

2-PH

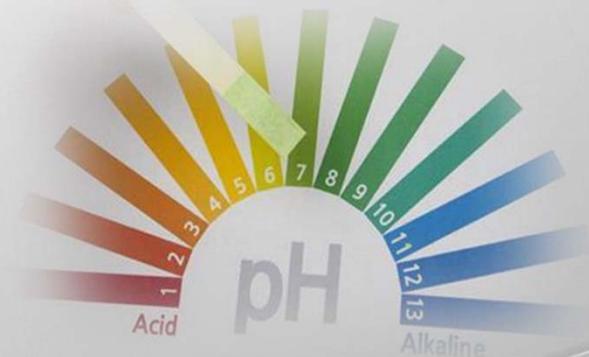
The pH affects the activity of enzymes that are involved in biosynthesis and growth

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 5.5**

Neutrophiles between **5.6 and 8.5**

Alkalophiles **8.6 to 11.5.**

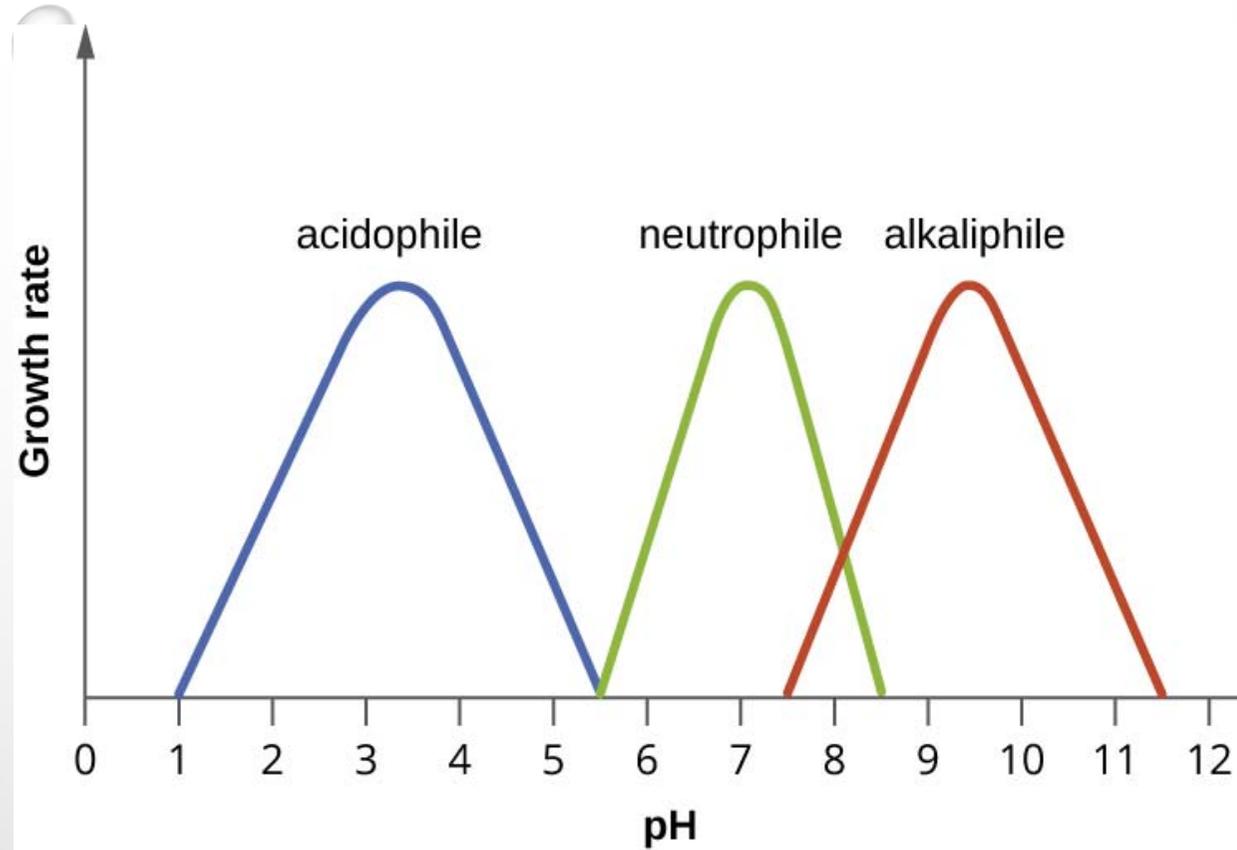


2-PH

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 can grow rapidly in an alkaline medium of water.

pH ranges for the growth

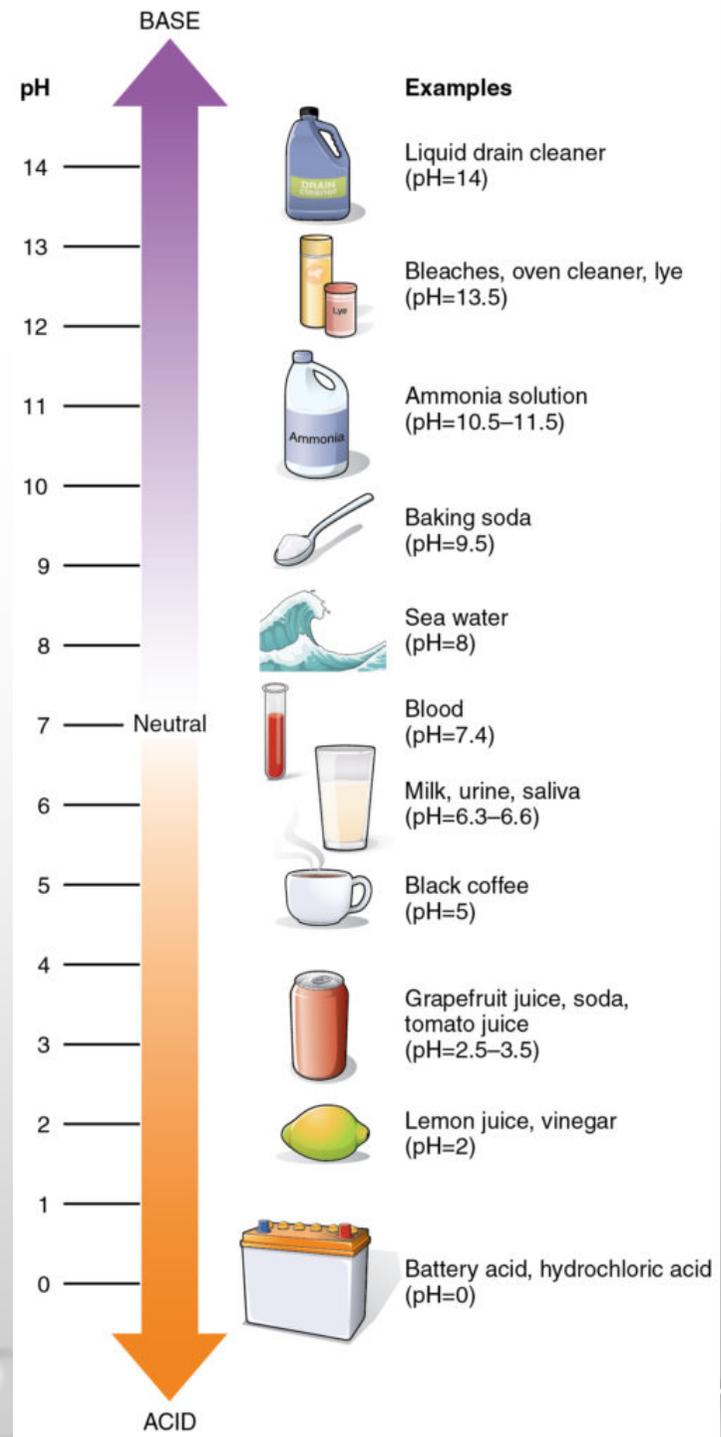


Each curve has an **optimal pH** and **extreme pH values** at which growth is much reduced.

Most bacteria are **neutrophiles** and **grow best at near-neutral pH** (centre curve).

Acidophiles have optimal growth at **pH values near 3** and **alkaliphiles** have optimal growth at **pH values above 9**.

pH Scale



3-Osmotic pressure

- Bacteria are separated from their environment by a selective permeable plasma membrane
- They can be affected by changes in the osmotic pressure or water availability of their surroundings.
- **Osmotic pressure:** the force developed within a cell due to movement of water across the cell membrane due to unequal solute concentrations (membrane is permeable only to the solvent/water)

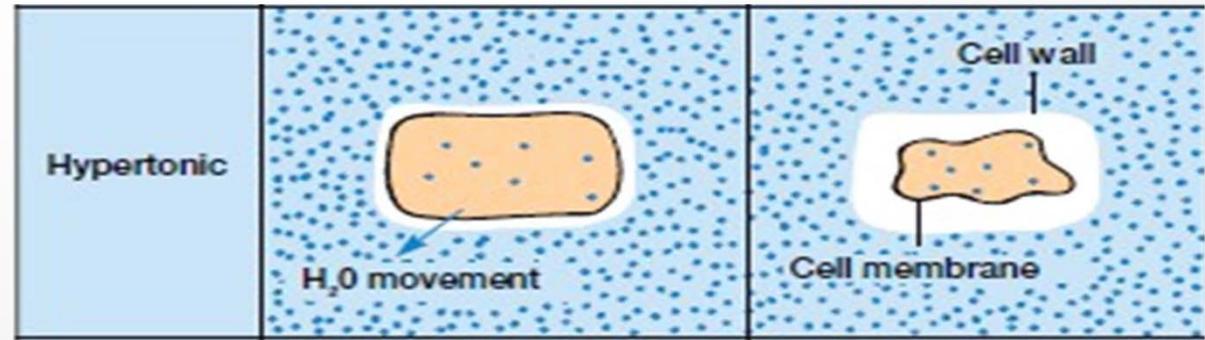
***The solvent** is the liquid, usually water, which dissolves a substance (**the solute**).

Definitions

1. **Osmosis:** the movement of water across a semipermeable membrane in response to differing solute concentrations on each side.

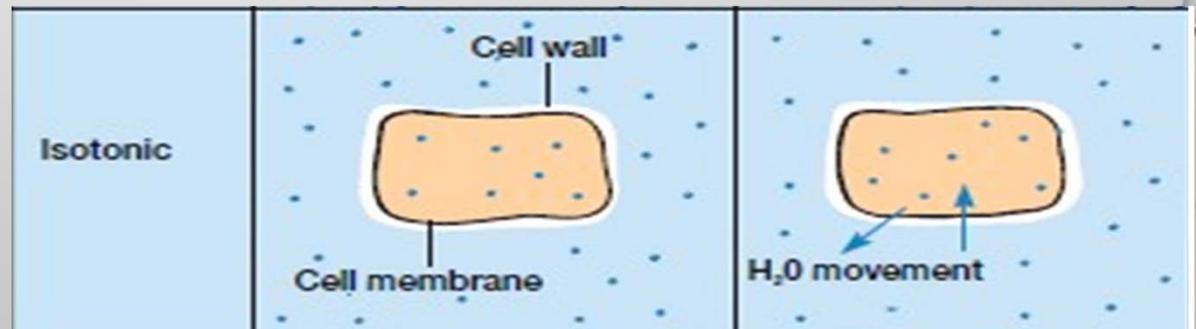
2. **Halophilic:** Bacteria that tolerate and grow well in hypertonic salt solutions.

- **3. Plasmolysis:** when the **plasma membrane shrinks** away from a microbial cell wall due to a **hypertonic solution**.



- **4. Isotonic solution** (iso means equal) , the **concentration of solutes is the same outside and inside the bacterium**.

- So the bacterium is in **osmotic balance** with its environment and **does not change volume**.

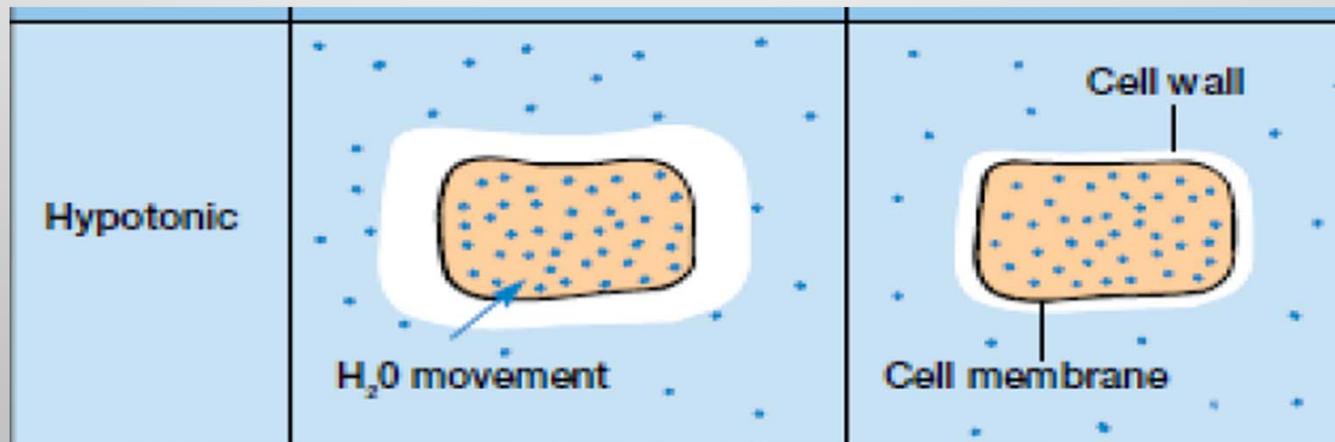


5. Hypotonic Solution:

In a hypotonic solution, the solute concentration is lower than inside the cell.

Under these conditions, the osmotic pressure forces water into the cell. Depending on the amount of water that enters, the cell may look enlarged.

***If the water continues to move into the cell, it can stretch the cell membrane to the point the cell bursts (lyses) and dies.**



Experiment

Each group will receive **Five Nutrient Agar (NA) plates** with the following NaCl concentrations: **0% (No salt), 0.5%, 5%, 10%, and 20% NaCl.**

1. Labeling

1. Clearly label each plate with the group name, date, bacterial strain, and NaCl concentration.
2. Write only on the **edge of the plate**, not on the lid.

2. Inoculation

- Streak the assigned bacterial strain onto each of the five plates using aseptic technique.

3. Incubation

- Incubate the plates **inverted** at **37°C for 24 hours.**

4. Observation and Recording

- After incubation, observe the **relative bacterial growth** on each plate
- (take pictures for the report).
- Enter your observations in the table provided below.
- Record growth using the following scale:
 - **(no growth), +, ++, +++, +++++ (maximum growth).**

Medium	<i>E. coli</i>
0.5% NaCl	
5% NaCl	
10% NaCl	
20% NaCl	