

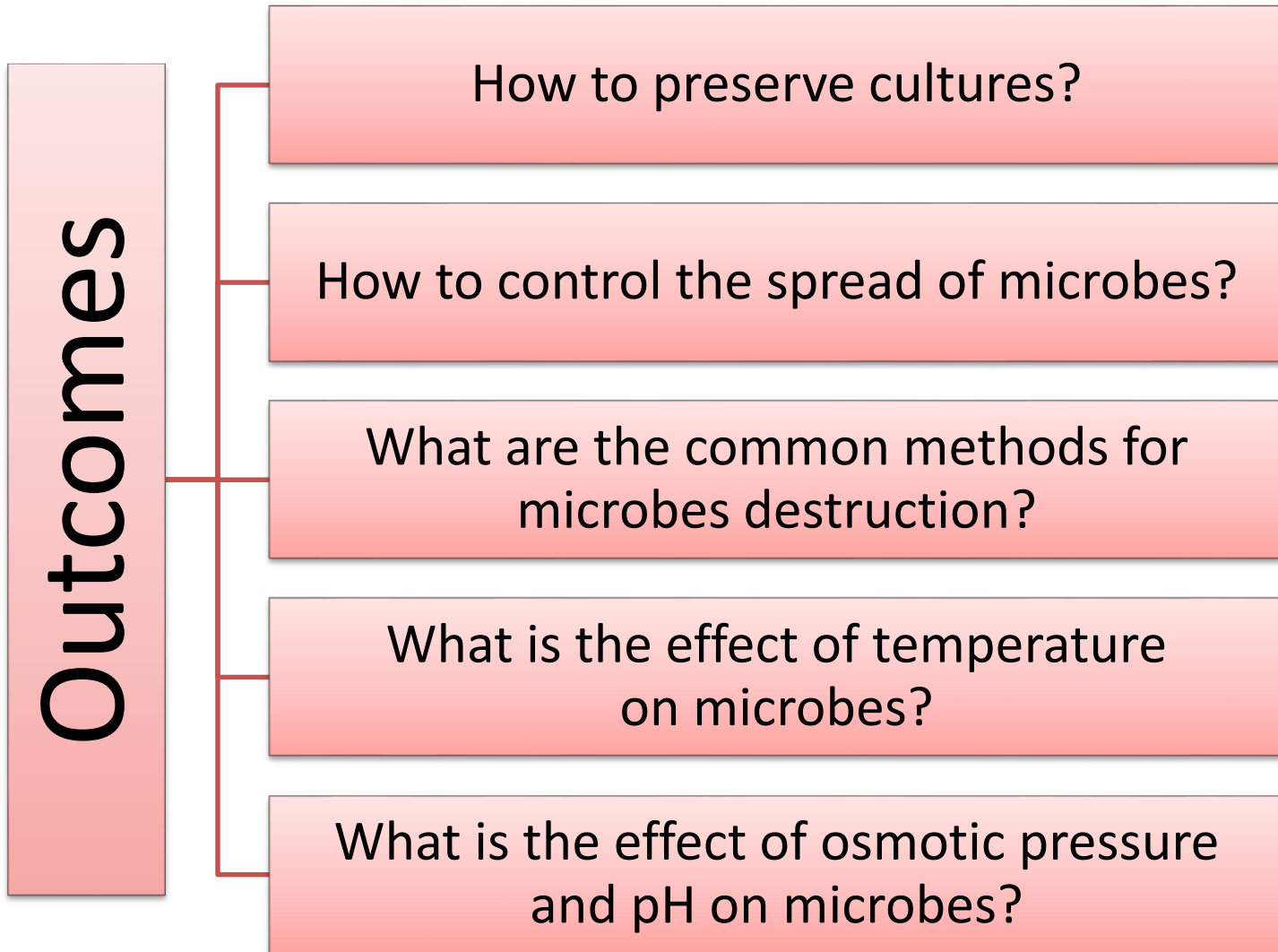


**OPT0425**  
**MICROBIOLOGY I**

**GAMAL EL-HITI**



# Learning Outcomes



# Microbial Growth Control

- How to preserve cultures?
- Refrigeration: Stores for short periods of time.
- Deep-freezing: It use a deep freezer ( $-85^{\circ}\text{C}$ ) to store cells for years.
- Lyophilization
  - It is a dehydration process.
  - Typically used to store cultures for decades.
  - One of the best ways to store a fungal, bacterial, yeast or other microorganism.

# Microbial Growth Control

- Freeze-drying works by freezing the material.
- The surrounding pressure was reduced.
- The frozen water in the material was sublimated directly from the solid phase to the gas phase.



A freeze-drier

# Microbial Growth Control

- Microbial growth means increase in number of cells, not cell size.
- One cell becomes colony of millions of cells.
- The control of microbial growth is necessary in many practical applications.
- **Microbial growth control is important for:**
  - Infection control
  - Growth of industrial and biotech organisms



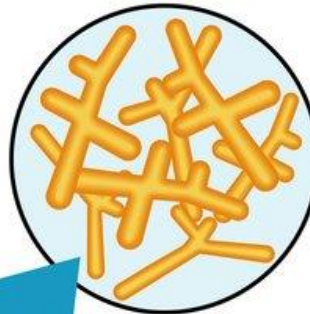
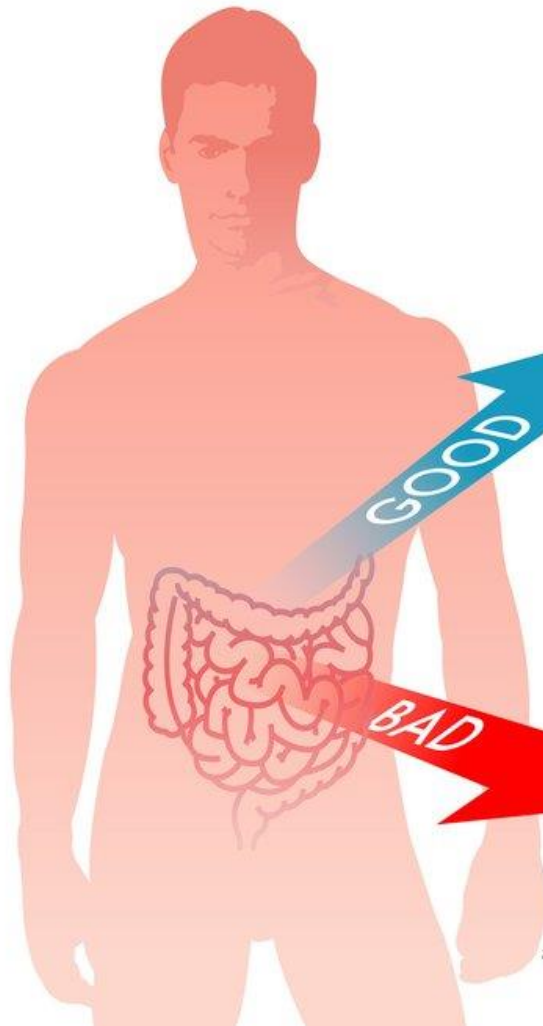
# Microbial Growth Control

- Most bacteria are harmless.
- Some bacteria are helping in food digestion, killing microbes and fighting viruses.
- Less than 1% of bacteria are pathogenic and cause illness.



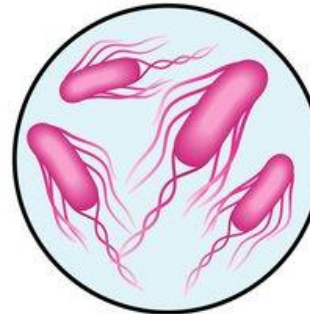
# Microbial Growth Control

## Good and Bad Bacterial Flora



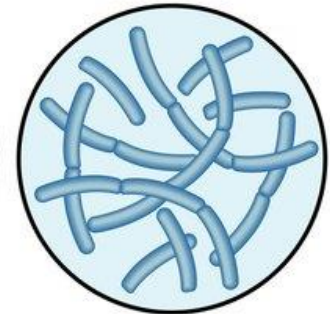
### BIFIDOBACTERIA

The various strains help to regulate levels of other bacteria in the gut, modulate immune responses to invading pathogens, prevent tumour formation and produce vitamins.



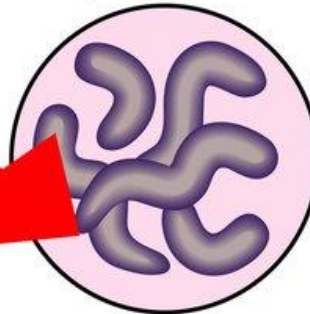
### ESCHERICHIA COLI

Several types inhabit the human gut. They are involved in the production of vitamin K2 (essential for blood clotting) and help to keep bad bacteria in check. But some strains can lead to illness.



### LACTOBACILLI

Beneficial varieties produce vitamins and nutrients, boost immunity and protect against carcinogens.



### CAMPYLOBACTER

C jejuni and C coli are the strains most commonly associated with human disease. Infection usually occurs through the ingestion of contaminated food.



### ENTEROCOCCUS FAECALIS

A common cause of post-surgical infections.



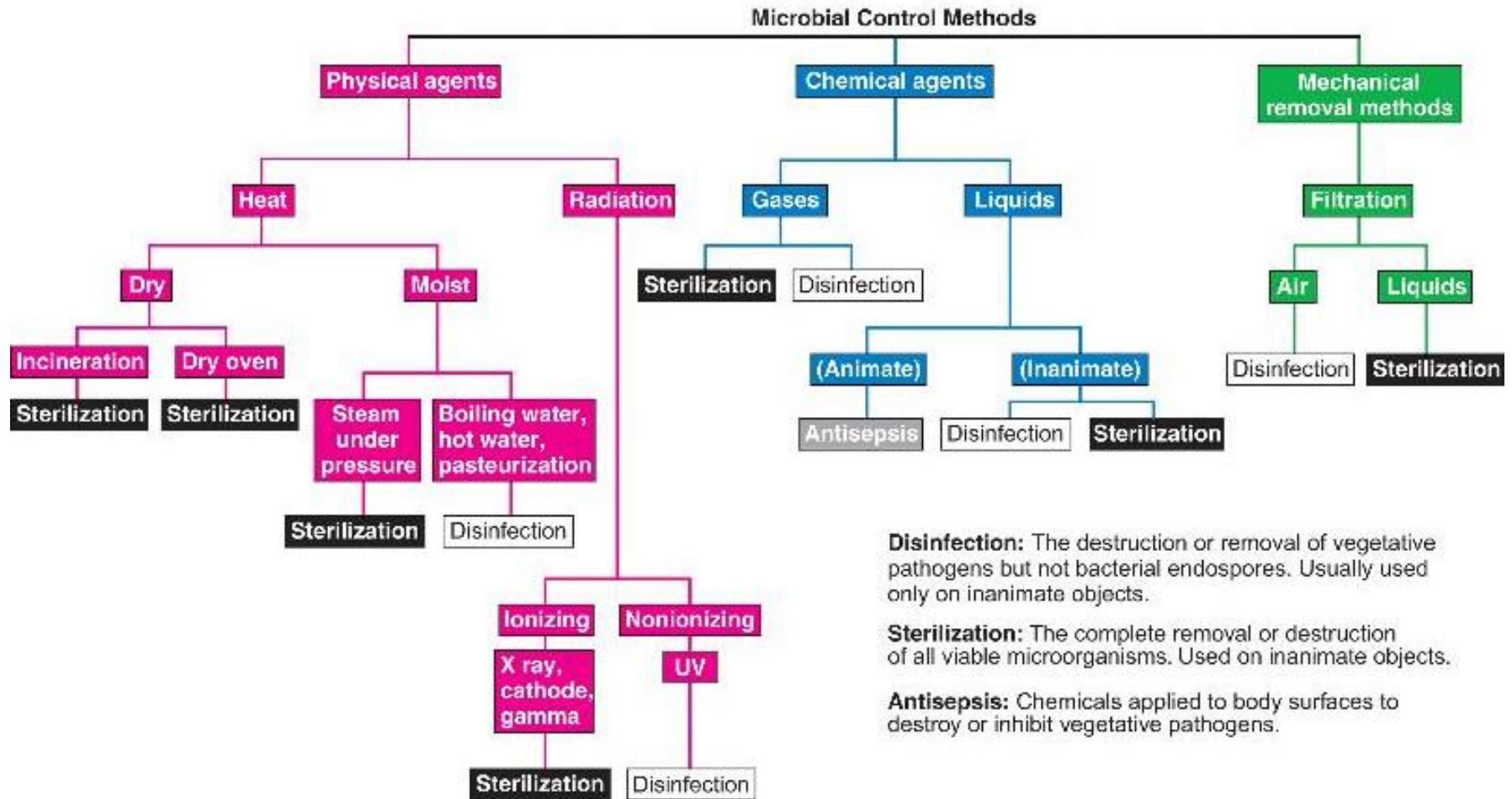
### CLOSTRIDIUM DIFFICILE

Most harmful following a course of antibiotics when it is able to proliferate.

# Microbial Growth Control



# Microbial Growth Control



# Microbial Growth Control

- How to control the spread of microbes and the methods of destruction?
- Three common practices are used to prevent the growth and the spread of microorganisms in community and hospitals which they are different in their power and the way to use.
  - Antiseptics
  - Disinfection
  - Sterilization

# Microbial Growth Control

- Antiseptics
- Solutions applied directly to skin.
- Prevent or slow down the growth of microorganisms.
- Alcohol and betadine are often used.
- Dettol (**chlorinated phenols**) used as a household antiseptic.
- Not useful against control of all microorganisms.



# Microbial Growth Control

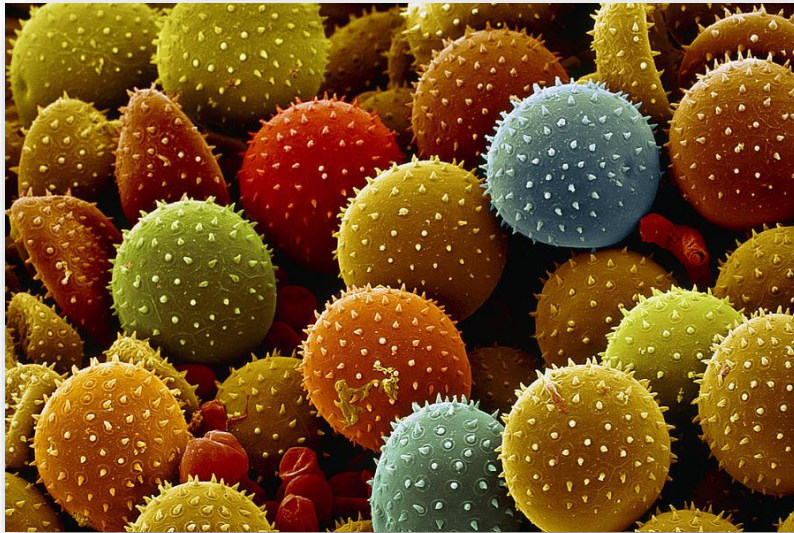
- Disinfection
- Uses strong chemicals such as **bleach** solution to kill many pathogens



- Used mainly on objects and not on the skin because they may cause skin irritation and trauma.

# Microbial Growth Control

- Disinfectants and antiseptics have limited effects against viruses and spores.
- Spores are cells produced by bacteria either to reproduce or to be resistant to a harsh environment.



# Microbial Growth Control

- Sterilization
- It is the best way to kill all microbes and their spores.
- Used to sterilize medical instruments.
- Uses steam under pressure.



# Microbial Growth Control

- Other methods include use of chemicals, radiation and gas.



- Not all microbes require sterilization to become nontoxic or non-pathogenic.
- Many microbes can be eliminated by disinfecting procedures.

# Microbial Growth Control

- Various factors affect the growth of microorganisms.
- **The most important factors are:**
  - Temperature
  - pH
  - Osmotic pressure
  - Oxygen
  - Generation time
  - Nutrients
  - Others, *e.g.* radiation

# Microbial Growth Control

- Requirements for microbial growth are divided into two categories, physical and chemical.
- Physical requirements for the growth of microbes includes the following:
  - 1– Temperature
    - Optimal temperature for microbes growth.
  - 2– pH
    - Optimal pH for enzyme operation.
  - 3– Osmotic pressure

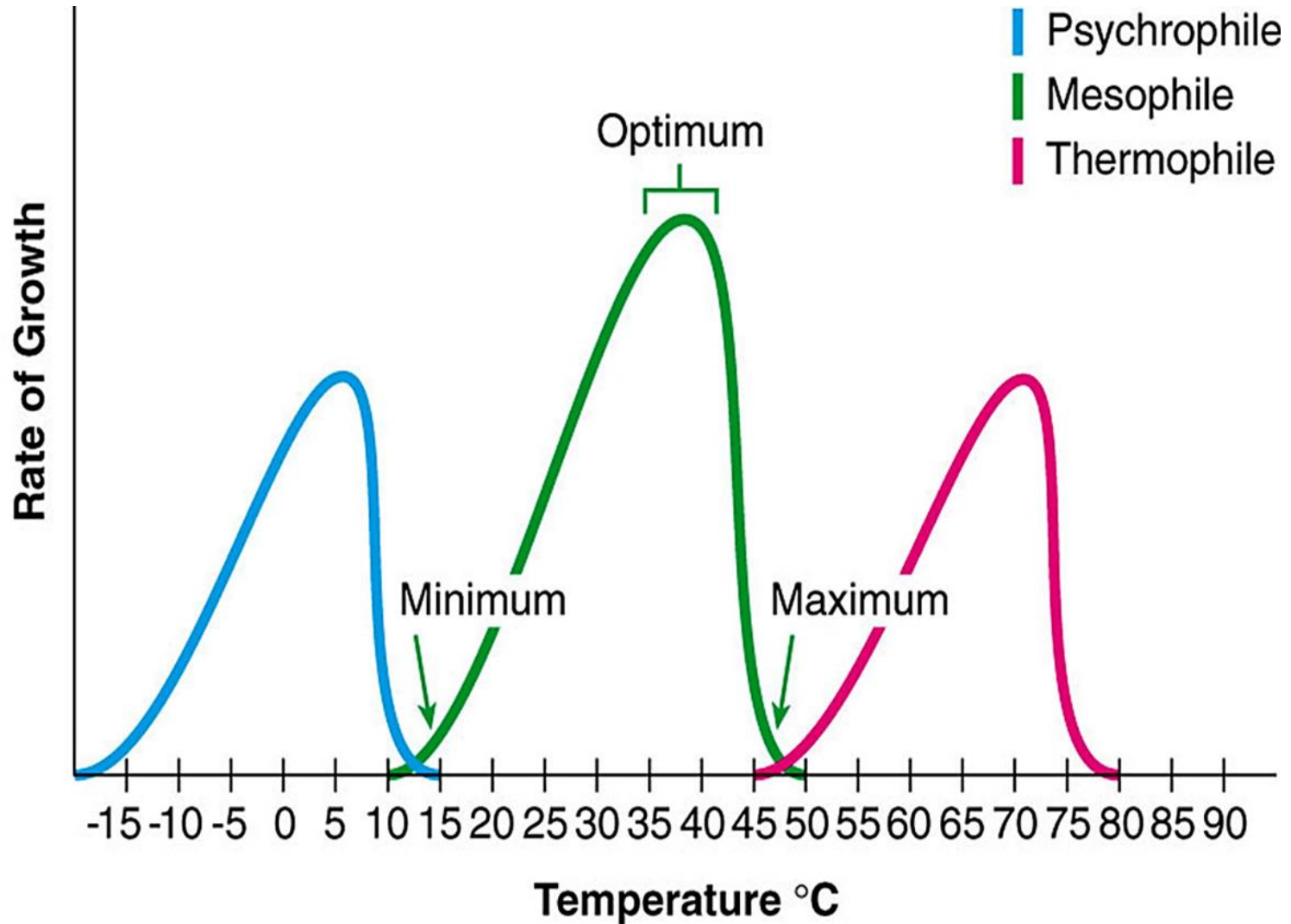
# Microbial Growth Control

- Microorganisms have been found growing in virtually all environments.
- Such environments should contain liquid water, regardless of its temperature.

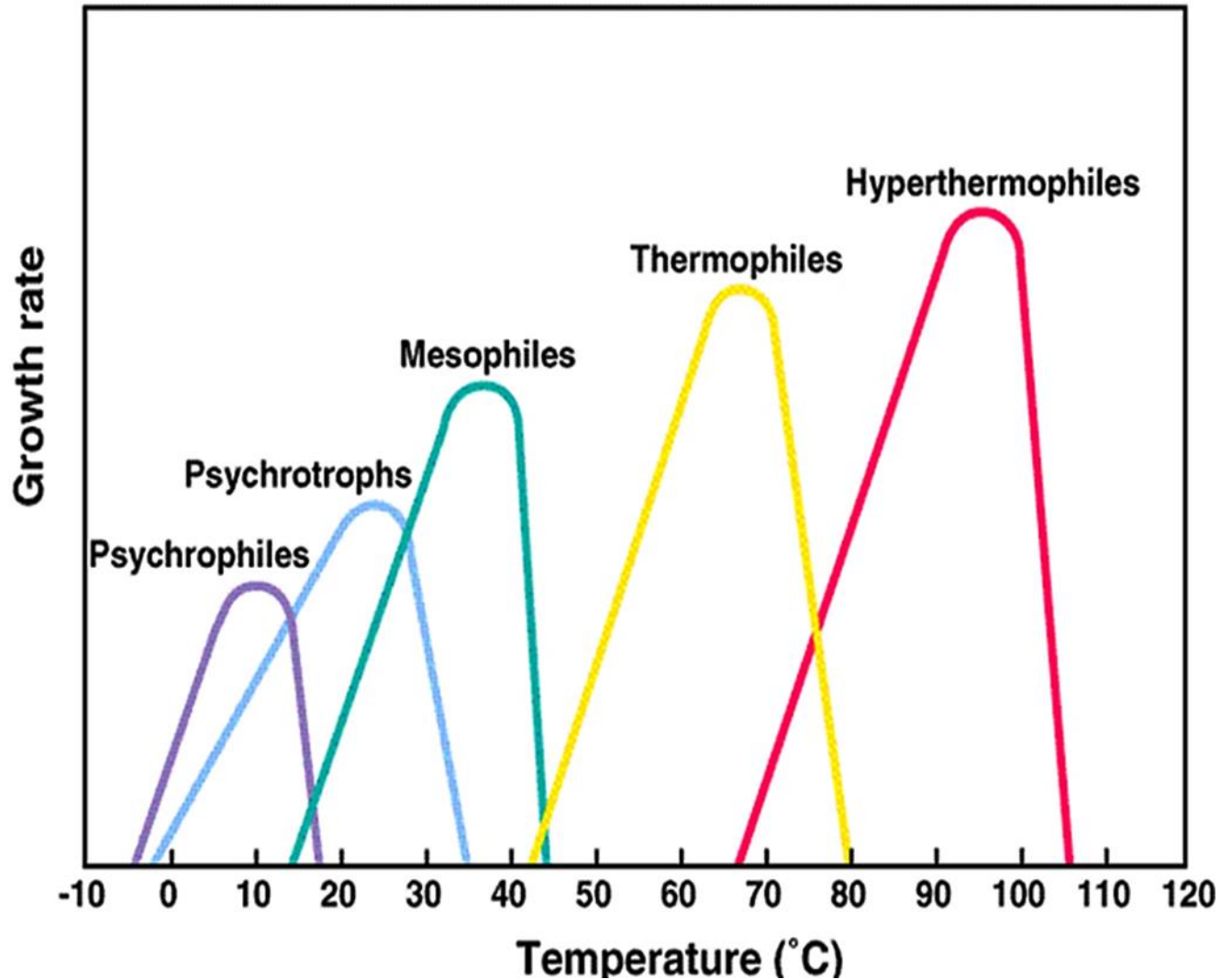
## 1– Temperature (optimal enzyme operation)

- Psychrophiles (cold–loving)
- Mesophiles (moderate temperature–loving)
- Thermophiles (heat–loving)
- Each has a minimum, optimum and maximum growth temperature.

# Microbial Growth Control



# Microbial Growth Control

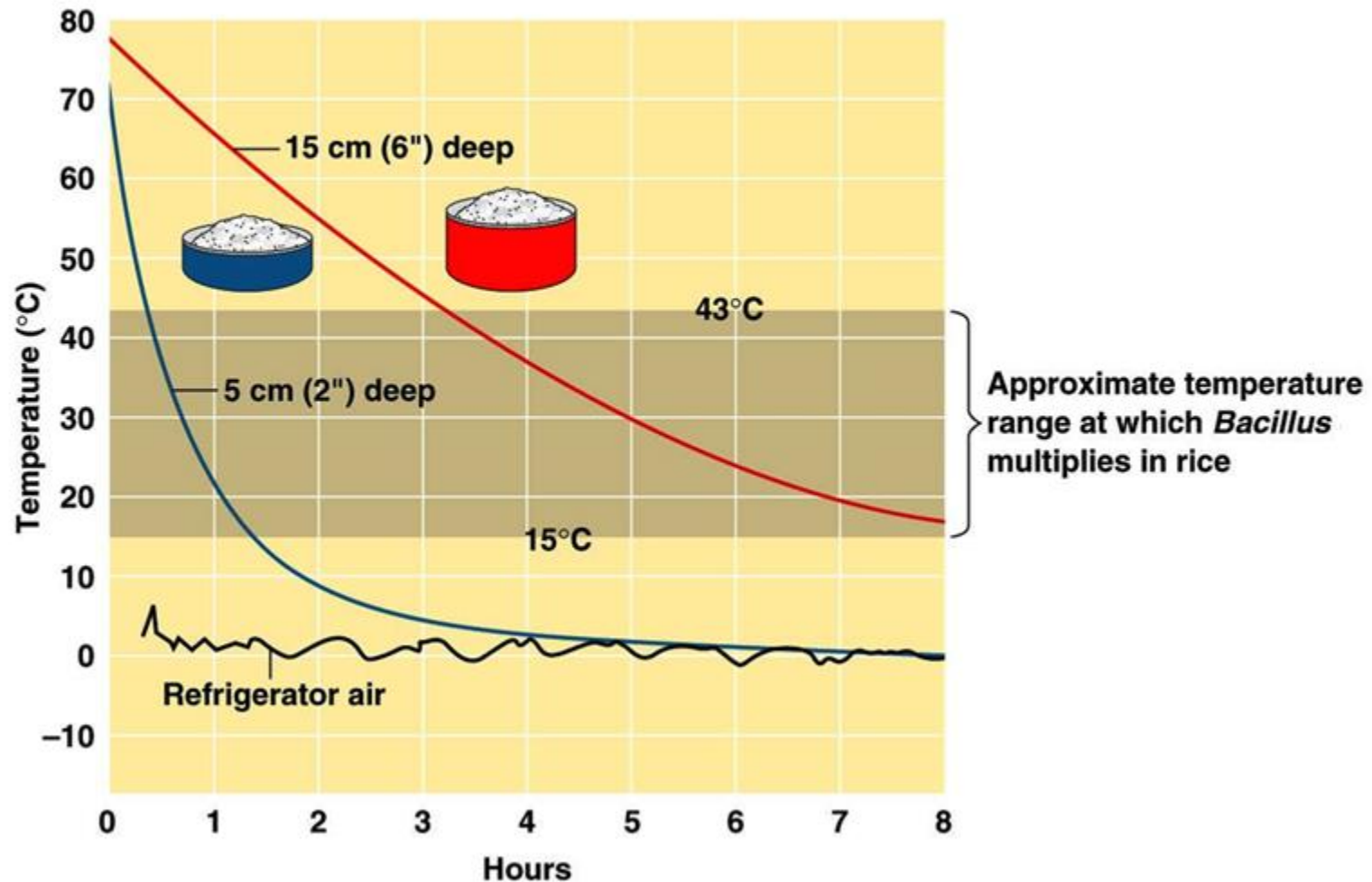


# Microbial Growth Control

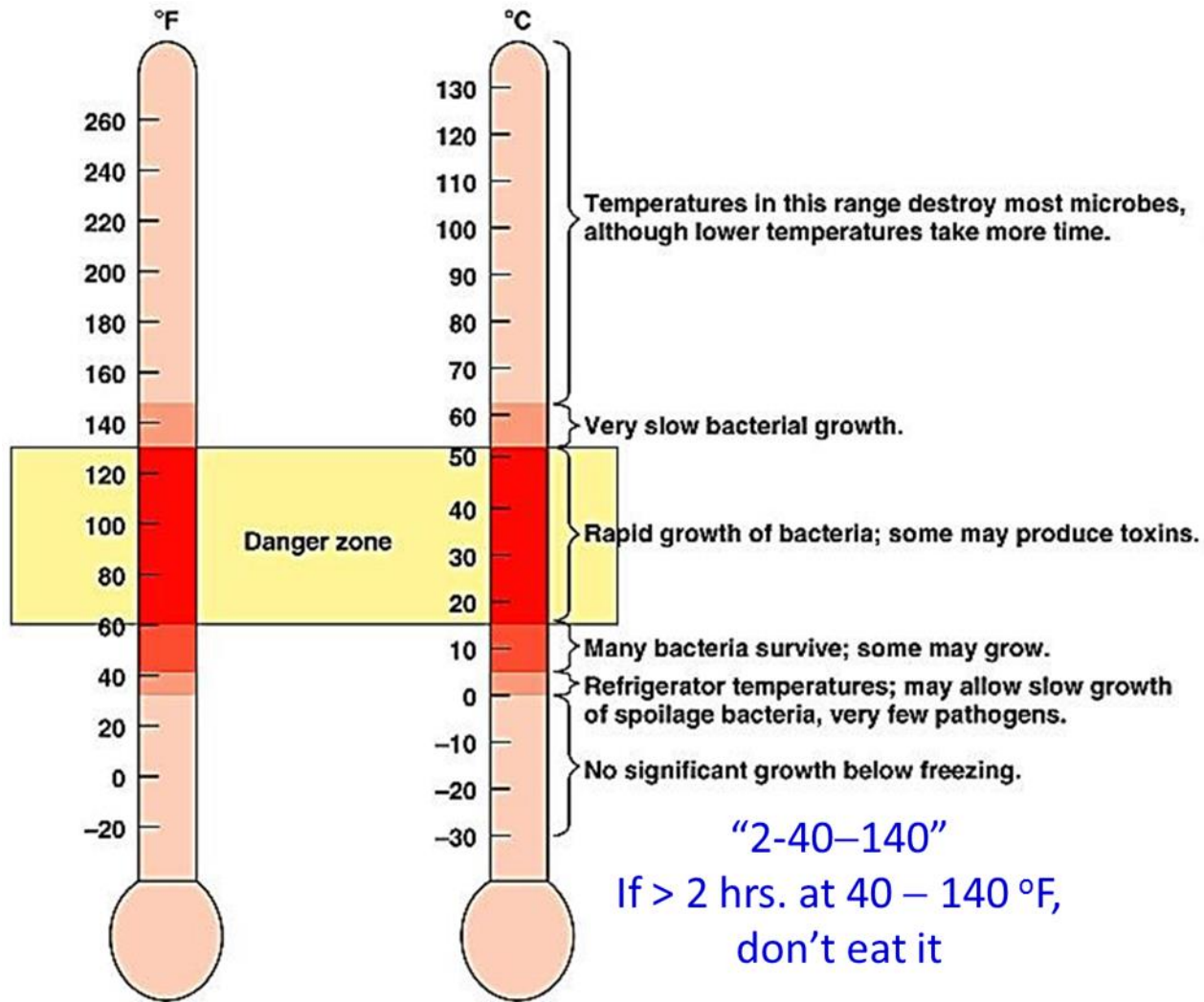
- Optimum temperature is the temperature at which an organism will grow at the most stable healthy rate.
- Optimum growth temperature is usually near the top of the growth range.
- Death above the maximum temperature comes from enzyme inactivation.
- Mesophiles (moderate temperature-loving) most common group of organisms.
- 40 °F (5 °C) slows or stops growth of most microbes.

# Microbial Growth Control

## Effect of amount of food on its cooling rate



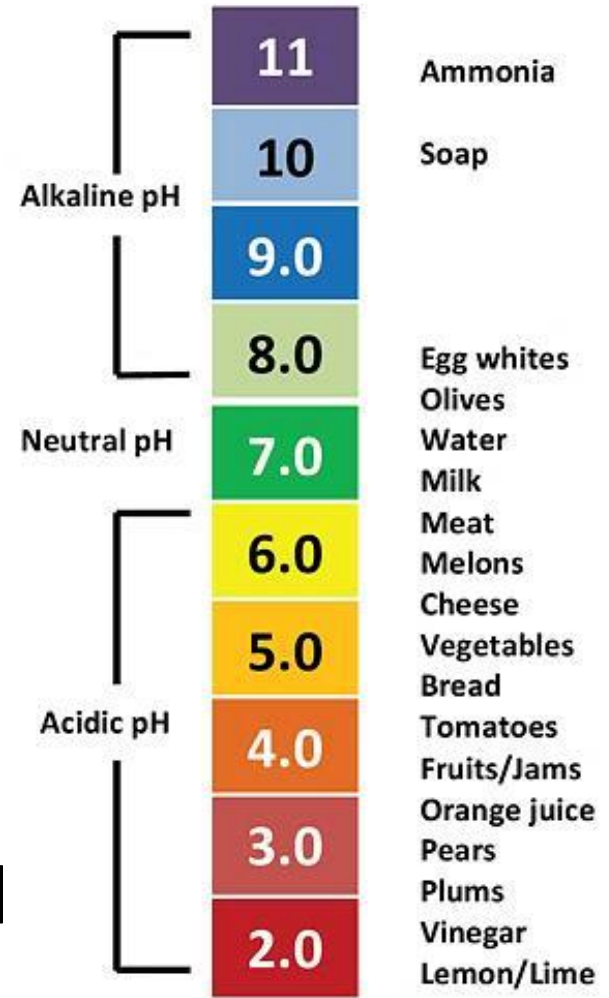
# Microbial Growth Control



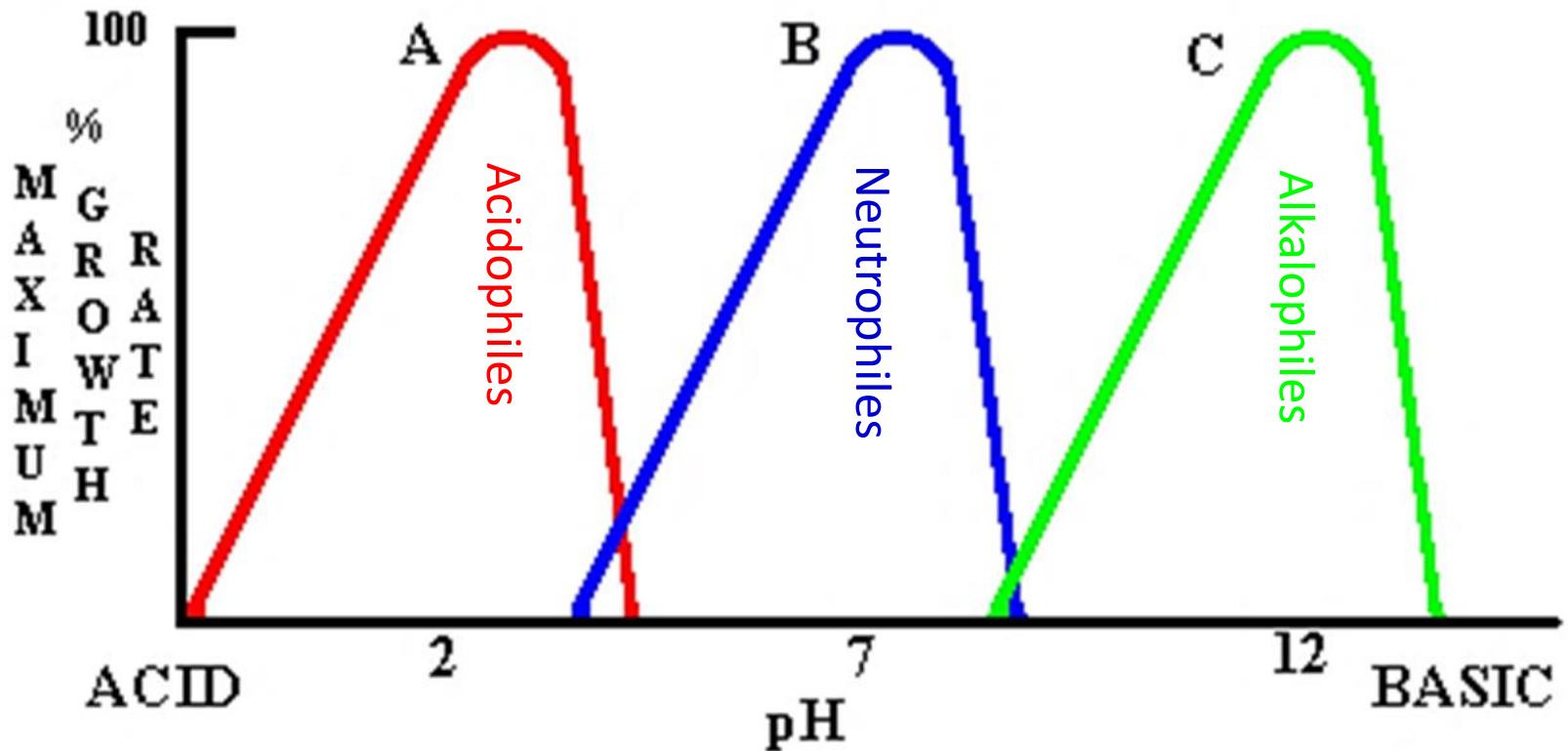
# Microbial Growth Control

## 2- pH

- Using buffers in media.
- Molds, yeasts, versus and bacteria are highly affected by pH.
- Microorganisms have an optimal pH range at which growth is possible and an optimum pH at which growth is at its highest.



# Microbial Growth Control



- Most bacteria grow between pH 6.5 and 7.5.
- Molds and yeasts grow between pH 5 and 6.

## 3– Osmotic pressure

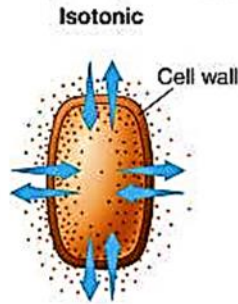
- Microbial growth proceeds best when the osmotic pressure is ideal.
- Normally, the salt concentration of microbial cytoplasm is about 1%.
- If the external environment also has a 1% salt concentration, then the osmotic pressure is optimum.
- When the external salt concentration rise water will flow out and the microbes shrink.

# Microbial Growth Control

- If exterior water is free of salt, it will flow into the cell and then swell and burst.
- Isotonic, hypotonic and hypertonic are known.
- Marine microorganisms can tolerate high salt concentrations (halophilic).
- **Obligate halophiles** require high osmotic pressure.
- **Facultative halophiles** tolerate high osmotic pressure.

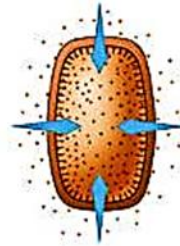
# Microbial Growth Control

Cells with Cell Wall



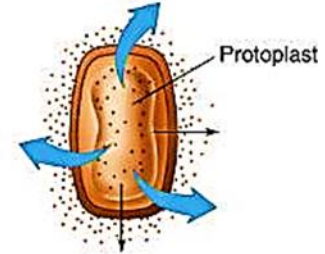
Water concentration is equal inside and outside the cell; thus, rates of diffusion are equal in both directions.

Hypotonic



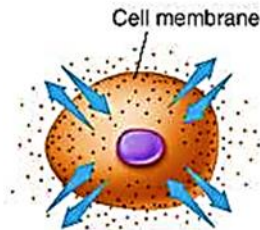
Net diffusion of water is into the cell; this swells the protoplast and pushes it tightly against the wall. Wall usually prevents cell from bursting.

Hypertonic

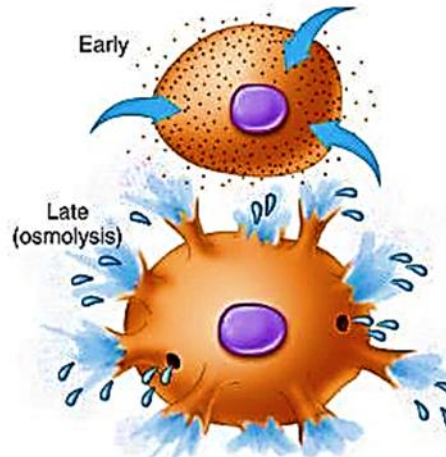


Water diffuses out of the cell and shrinks the protoplast away from the cell wall; process is known as *plasmolysis*.

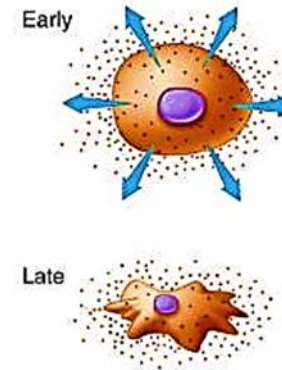
Cells Lacking Cell Wall



Rates of diffusion are equal in both directions.



Diffusion of water into the cell causes it to swell, and may burst it if no mechanism exists to remove the water.



Water diffusing out of the cell causes it to shrink and become distorted.

➡ Direction of net water movement

# Microbial Growth Control

Hypertonic

Isotonic

Hypotonic

