

Chapter 7 Elements of Microbial Nutrition, Ecology and Growth

Building Your Knowledge

- 1) What is the process by which organisms acquire nutrients from the environment?
- 2) How do essential nutrients differ from nonessential nutrients?
- 3) Differentiate between micronutrients and macronutrients.

Category	Quantities Used	Use in Bacterial Cell	Examples
Macronutrients			
Micronutrients			

- 4) What is the difference between heterotrophs and autotrophs?

Autotrophs get carbon from _____

Heterotrophs get carbon from _____

- 5) How do photoautotrophs and chemoautotrophs differ in how they get energy?

Photoautotrophs get energy _____

Chemoautotrophs get energy _____

- 6) Photosynthetic algae get carbon and energy from _____.

- 7) Humans and most bacteria are _____ (autotrophs or heterotrophs).

- 8) What is the difference between saprobes and parasites/pathogens?

- 9) Can obligate parasites be cultured using solid, synthetic media?

- 10) All viruses and some bacteria are obligate intracellular parasites. Name one bacterial species and one virus that is an obligate intracellular parasite.

a. _____

b. _____

11) Without the addition of energy, do molecules move from high concentrations to low concentrations or from low concentrations to high concentrations? Explain your answer.

12) Draw a cell in hypertonic, isotonic and hypotonic solutions. Use x's to indicate solute molecules. Which cells shrink? Which swell?

Hypertonic	Isotonic	Hypotonic

What does a bacterial cell wall protect against?

13) How are facilitated diffusion and active transport similar?

How are they different?

Do both require energy?

14) When is active transport necessary?

What advantage does group translocation have over simple pumps?

15) What are the three cardinal temperatures of microbial growth?

16) Do all microbes have similar temperature ranges? Explain.

17) What are psychrophiles, mesophiles, and thermophiles?

Which are of concern to food microbiologists?

Which are most commonly pathogenic?

18) How do the oxygen requirements of obligate aerobes, facultative anaerobes, microaerophiles and obligate anaerobes differ?

19) How would each grow in thioglycolate broth? Draw each test tube.

Obligate aerobe	Microaerophile	Obligate Anaerobe	Facultative Anaerobe

20) Halophiles live in extreme _____ conditions.

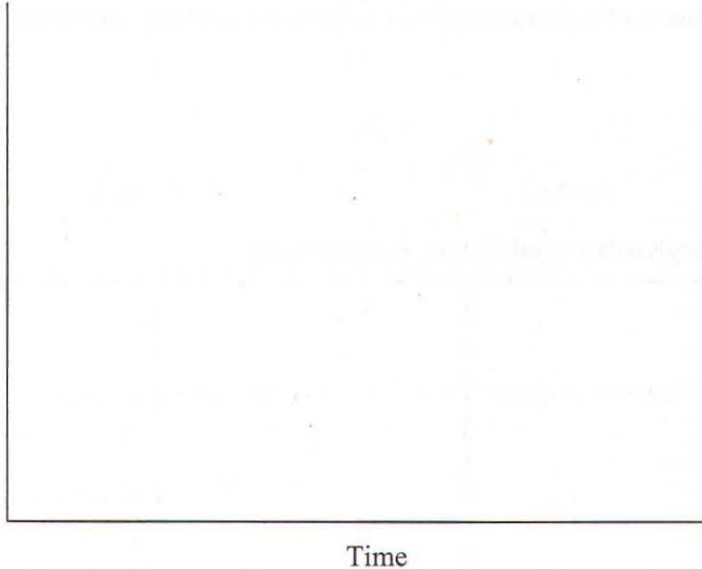
21) Barophiles live in extreme _____ conditions.

22) How do bacteria reproduce? Draw the process of binary fission below.

23) If you place 100 bacterial cells in media and their doubling time is 30 minutes, how many cells are in the media at the end of 5 hours?

24) Do all bacteria reproduce at the same rate? Explain and give examples.

25) Draw a growth curve of bacteria in batch culture, labeling lag phase, log phase, stationary phase and death phase.



26) Which stage has the fastest-growing bacteria?

27) Why do cultures move from log phase to stationary phase?

28) Why do cultures move from stationary to death phase?

29) How may we count bacteria? (list 3 ways) Which methods count live cells only?

Organizing Your Knowledge

Type of Bacteria	Living Conditions Preferred
Psychrophile	
	Acidic pH
Obligate anaerobe	
	Small amounts of oxygen
Alkaliphile	
	Extreme salt conditions
Osmophile	
	Moderate temperatures
Barophile	
	Extreme heat
Obligate Aerobe	
	Can grow with or without oxygen

Micronutrient	Use in Bacterial Cells
Potassium	
Sodium	
Calcium	
Magnesium	
Iron	

Macronutrient	Use in Bacterial Cells	Source or Environmental Reservoir
Carbon		Autotrophs
		Heterotrophs
Nitrogen		
Oxygen		
Phosphorus		
Sulfur		

Relationship	Interaction (+/+, +/-, +/-, etc.)	Symbiotic (yes/no?)
Mutualism		
Commensalism		
Parasitism		
Synergism		
Antagonism		

Stage of Growth Curve	What's Happening?	Growth Speed (fast/slow/level)	Live/dead cell ratio
Lag phase			
Exponential phase			
Stationary phase			
Death phase			

Practicing Your Knowledge

1. If placed in a hypertonic solution, most bacterial cells will _____.
 - a. burst if they lack a cell wall
 - b. remain unchanged
 - c. shrink and die
 - d. change color
2. Bacteria preferring low temperatures for optimum growth are called _____.
 - a. barophiles
 - b. halophiles
 - c. thermophiles
 - d. psychrophiles
3. Macronutrients are required by cells in _____ quantities and are used to _____.
 - a. small : boost enzyme function
 - b. large : boost enzyme function
 - c. small : form cell structures
 - d. large : form cell structures
4. Which of the following methods measures live bacterial cells only?
 - a. turbidity
 - b. plate counts
 - c. cytometer
 - d. Coulter counter
5. Which of the following transport processes requires energy?
 - a. diffusion
 - b. osmosis
 - c. facilitated diffusion
 - d. group translocation
6. Which of the following microbial associations is NOT symbiotic?
 - a. mutualism
 - b. commensalism
 - c. synergism
 - d. parasitism
7. Which phase of the growth curve sees an equal rate of bacterial death and reproduction?
 - a. lag phase
 - b. stationary phase
 - c. exponential phase
 - d. death phase
8. Strict halophiles are commonly human pathogens.
 - a. True
 - b. False
9. Photosynthetic bacteria are considered _____.
 - a. nonexistent—bacteria don't have chloroplasts
 - b. heterotrophs because they feed off dead things
 - c. autotrophs because they get their carbon from carbon dioxide
 - d. saprobes because they feed off dead things
10. As a bacterial culture grows, the media _____.
 - a. gets thicker because of all the bacteria
 - b. gets cloudier because of all the bacteria
 - c. gets warmer because of the heat generated by bacterial cells
 - d. gets clearer because the bacteria consume all the nutrients
11. What is the correct order for a growth curve progression, with bacterial cells in batch culture?
 - a. lag phase - exponential - stationary
 - b. stationary - lag phase - exponential
 - c. exponential - stationary - lag phase
 - d. lag phase - stationary - exponential
12. Bacteria lacking superoxide dismutase and catalase are _____.
 - a. strict aerobes
 - b. strict anaerobes
 - c. facultative anaerobes
 - d. strict acidophiles
13. What are the three cardinal temperatures for microbial growth?
 - a. hypertonic, isotonic and hypotonic
 - b. minimum, maximum and optimum
 - c. aerobic, anaerobic and microaerobic
 - d. halophile, barophile, osmophile

14. Active transport mechanisms are required to ____

- a. move nutrients from high to low concentrations
- b. move any nutrient across a plasma membrane
- c. complete facilitated diffusion
- d. move molecules from low to high concentrations

15. Most human pathogens are ____.

- a. mesophiles
- b. psychrophiles
- c. thermophiles
- d. psychrotrophs