

Chapter 01: Bacterial Cell Structure, Physiology, Metabolism, and Genetics

Mahon: Textbook of Diagnostic Microbiology, 6th Edition

MULTIPLE CHOICE

1. To survive, microbial inhabitants have learned to adapt by varying all of the following, *except*
 - a. growth rate.
 - b. growth in all atmospheric conditions.
 - c. growth at particular temperatures.
 - d. bacterial shape.

ANS: D

The chapter begins by discussing the way microbial inhabitants have had to evolve to survive in many different niches and habitats. It discusses slow growers, rapid growers, and replication with scarce or abundant nutrients, under different atmospheric conditions, temperature requirements, and cell structure. Bacterial shape as a form of evolution is not discussed.

OBJ: Level 2: Interpretation

2. Who was considered the father of protozoology and bacteriology?
 - a. Anton van Leeuwenhoek
 - b. Louis Pasteur
 - c. Carl Landsteiner
 - d. Michael Douglas

ANS: A

The book discusses Anton van Leeuwenhoek as the inventor of the microscope and the first person to see the “beasties.” So they dubbed him the father of protozoology and bacteriology. The other three individuals were not discussed.

OBJ: Level 1: Recall

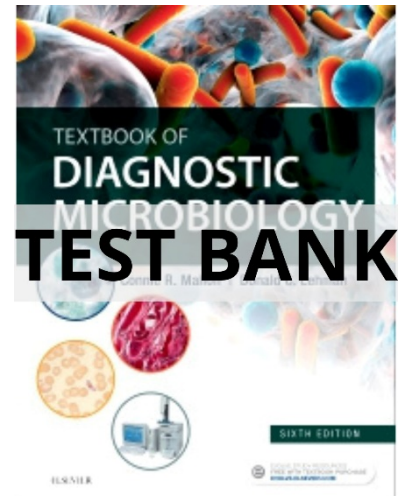
3. Prokaryotic cells have which of the following structures in their cytoplasm?
 - a. Golgi apparatus
 - b. Ribosomes
 - c. Mitochondria
 - d. Endoplasmic reticulum

ANS: B

All the structures listed are found in eukaryotic cells, but ribosomes are the only ones that apply to prokaryotic cells.

OBJ: Level 1: Recall

4. This form of DNA is commonly found in eukaryotic cells.
 - a. Linear
 - b. Circular
 - c. Plasmid



d. Colloid

ANS: A

Circular and plasmid DNA are usually found only in bacteria, not eukaryotic cells. Colloid is a property of protein molecules and is not associated with nucleotides.

OBJ: Level 1: Recall

5. The nuclear membrane in prokaryotes is
- missing.
 - impenetrable.
 - a classic membrane.
 - a lipid bilayer membrane.

ANS: A

Prokaryotic cells do not have any membrane-bound structures in the cytoplasm including a structured nucleus.

OBJ: Level 1: Recall

6. A microorganism that is a unicellular organism and lacks a nuclear membrane and true nucleus belongs to which classification?
- Fungi
 - Bacteria
 - Algae
 - Parasite

ANS: B

Fungi, algae, and parasites are unicellular eukaryotic organisms that contain a true nucleus. Bacteria are prokaryotic and do not contain a true nucleus or nuclear membrane.

OBJ: Level 1: Recall

7. In the laboratory, the clinical microbiologist is responsible for all the following, *except*
- isolating microorganisms.
 - selecting treatment for patients.
 - identifying microorganisms.
 - analyzing bacteria that cause disease.

ANS: B

Clinical microbiologists do not select the treatment for patients. They provide the doctor with the name of the organism and the antibiotics that can kill the bacteria, but not in the final selection of treatment protocols.

OBJ: Level 2: Recall

8. What enables the microbiologist to select the correct media for primary culture and optimize the chance of isolating a pathogenic organism?
- Determining staining characteristics
 - Understanding the cell structure and biochemical pathways of an organism
 - Understanding the growth requirements of potential pathogens at specific body site
 - Knowing the differences in cell walls of particular bacteria

ANS: C

By understanding growth requirements, a microbiologist can maximize the chance of the organism being isolated from a culture. The other three choices are used to identify a bacterium once it has grown on media.

OBJ: Level 2: Interpretation

9. A clinical laboratory scientist is working on the bench, reading plates, and notices that a culture has both a unicellular form and a filamentous form. What type of organism exhibits these forms?
- Virus
 - Fungi
 - Bacteria
 - Parasite

ANS: B

Viruses typically only have one form and would not grow on plate media. Bacteria have two forms: a vegetative cell and spore form. Parasites may have trophozoite, cysts, egg, etc. Fungi are the organism classification that may have both unicellular yeast forms and filamentous hyphal forms in the same culture plate.

OBJ: Level 2: Interpretation

10. All of the following statements are true about viruses, *except*:
- Viruses consist of DNA or RNA but not both.
 - Viruses are acellular but are surrounded by a protein coat.
 - Viruses can infect bacteria, plants, and animals.
 - Viruses do not need host cells to survive and grow.

ANS: D

Viruses need to have a host cell because they do not have the ability to reproduce or nourish themselves without the host's cellular mechanisms.

OBJ: Level 2: Interpretation

11. Diagnostic microbiologists apply placement and naming of bacterial organisms into all the following categories, *except*
- order.
 - family.
 - genus.
 - species.

ANS: A

Clinical microbiologists use the family, genus, and species taxonomic categories to identify species that are important for diagnostic diseases.

OBJ: Level 1: Recall

12. Bacterial species that exhibit phenotypic differences are considered
- biovarieties.
 - serovarieties.
 - phagevarieties.
 - subspecies.

ANS: D

Biovarieties vary based on biochemical test results, serovarieties vary based on serologic test results, and phagevarieties is a fictitious word.

OBJ: Level 2: Interpretation

13. What structure is described as a phospholipid bilayer embedded with proteins and sterols that regulates the type and amount of chemicals that pass in and out of a cell?
- Cell wall
 - Mitochondria
 - Endoplasmic reticulum
 - Plasma membrane

ANS: D

The cell wall is the outer covering made up of lipids. The mitochondria is a cellular organelle that is considered the powerhouse of the cell (electron transport and oxidative phosphorylation occur here). The endoplasmic reticulum is a cellular organelle where protein synthesis occurs.

OBJ: Level 1: Recall

14. What makes the interior of the plasma membrane potentially impermeable to water-soluble molecules?
- The hydrophobic tails of the phospholipid molecules are found there.
 - The hydrophilic tails of the phospholipid molecules are found there.
 - The ion channels are found there.
 - The cholesterol molecules in the plasma membrane are found solely in the interior of the membrane.

ANS: A

The plasma membrane is designed so that the hydrophilic heads of the phospholipid molecules are positioned to make contact with the intracellular and extracellular fluids. The hydrophobic tails of the phospholipid molecules face away from the fluids and form the interior of the plasma membrane. The tails of the phospholipid molecules are hydrophobic, not hydrophilic. The ion channels extend through the cellular membrane. The cholesterol molecules also extend through the plasma membrane.

OBJ: Level 2: Interpretation

15. The function of a cell wall is to
- regulate the transport of macromolecules in and out of the cell.
 - provide rigidity and strength to the exterior of the cell.
 - provide reserve energy to the eukaryotic cell.
 - protect the eukaryote from predators.

ANS: B

The plasma membrane regulates the transport of macromolecules in and out of the cell, not the cell wall. The mitochondria provide energy to the eukaryotic cell. Cell walls are not able to protect a eukaryotic cell from predators.

OBJ: Level 1: Recall

16. Name the numerous short (3 to 10 μm) projections that extend from the cell surface and are used for cellular locomotion.
- Flagella
 - Mitochondria
 - Cilia
 - Phospholipid

ANS: C

By definition, cilia are short projections extending from the cell surface and are used for locomotion, whereas flagella are longer projections used for locomotion. Mitochondria are cellular organelles responsible for electron transport and oxidative phosphorylation. Phospholipids are polar molecules that form the plasma membrane.

OBJ: Level 1: Recall

17. A microbiology technologist performs a traditional bacterial stain on a colony from a wound culture that is suspected to contain bacteria from the genus *Clostridium*. The unstained areas in the bacterial cell observed by the technologist are called
- cilia.
 - ribosomes.
 - endospores.
 - mitochondria.

ANS: C

Ribosomes are small circular areas used for protein synthesis that are not visible on a traditional stain. Cilia are short projections on the outside of the plasma membrane used for locomotion. Mitochondria are cellular organelles used for energy production.

OBJ: Level 2: Interpretation

18. This constituent of a gram-positive cell wall absorbs crystal violet but is not dissolved by alcohol, thus giving the gram-positive cell its characteristic purple color.
- Mycolic acid
 - Cholesterol
 - Carbolfuchsin
 - Peptidoglycan

ANS: D

Mycolic acid is part of the cell wall of the *Mycobacterium* and *Nocardia* spp., but does not play a part in the Gram stain. Cholesterol is also part of the cell membrane, not the cell wall, so it does not play a part in the Gram stain. Carbolfuchsin is a stain used in bacteriology.

OBJ: Level 2: Interpretation

19. Mycobacteria have a gram-positive cell wall structure with a waxy layer containing these two compounds.
- Glycolipids and mycolic acid
 - Glycolipids and phospholipids
 - Mycolic acid and lipopolysaccharides
 - Lipopolysaccharides and phospholipids

ANS: A

Glycolipids are a part of the waxy layer, but phospholipids are part of the plasma membrane. Mycolic acid is a part of the waxy layer, but lipopolysaccharides are part of a gram-negative cell wall. Lipopolysaccharides are part of a gram-negative wall, and phospholipids are part of a plasma membrane.

OBJ: Level 1: Recall

20. When performing a Gram stain on a gram-negative organism, the crystal violet is absorbed into this outer cell wall layer, and then washed away with the acetone alcohol. What is the main component of the outer layer of the cell wall?
- Peptidoglycan
 - Mycolic acid
 - N*-acetyl-D-muramic acid
 - Lipopolysaccharide

ANS: D

Peptidoglycan is a thinner layer under the lipopolysaccharide in a gram-negative organism, whereas mycolic acid is the waxy layer present in a mycobacterium's outer cell wall, and *N*-acetyl-D-muramic acid is part of the peptidoglycan.

OBJ: Level 1: Recall

21. The three regions of the lipopolysaccharide include all the following, *except*
- antigenic O-specific polysaccharide.
 - mycolic acid.
 - core polysaccharide.
 - endotoxin (inner lipid A).

ANS: B

Antigenic O-specific polysaccharide, core polysaccharide, and endotoxin are all part of the lipopolysaccharide layer.

OBJ: Level 1: Recall

22. The outer cell wall of the gram-negative bacteria serves three important functions, which includes all the following, *except*:
- It provides an attachment site for the flagella, which will act in locomotion.
 - It acts as a barrier to hydrophobic compounds and harmful substances.
 - It acts as a sieve.
 - It provides attachment sites that enhance adhesion to host cells.

ANS: A

The outer cell wall of gram-negative bacteria acts as a barrier to hydrophobic compounds and harmful substances, acts as a sieve, and provides attachment sites that enhance adhesion to host cells. Flagella attach to the cell membrane, not to the cell wall.

OBJ: Level 1: Recall

23. *Mycoplasma* and *Ureaplasma* spp. must have media supplemented with serum or sugar as nutrients and because
- their cell walls contain only peptidoglycan.
 - they lack cell walls.
 - the sterols in their cell walls are soluble in normal bacterial media.

- d. their cell walls contain detoxifying enzymes.

ANS: B

These two genera have no cell walls, so the other choices are not appropriate. Serum and sugar are needed nutrients and assist with osmotic balance of the media.

OBJ: Level 1: Recall

24. What is the purpose of a capsule?
- a. Prevent osmotic rupture of the cell membrane
 - b. Make up the periplasmic space
 - c. Act as a virulence factor in helping the pathogen evade phagocytosis
 - d. Provide an attachment site for somatic antigens

ANS: C

The capsule acts as a virulence factor in helping the pathogen evade phagocytosis because antibodies have difficulty attaching to the capsule of bacteria and therefore are unable to prepare the organism for ingestion. The cell membrane is not prone to osmotic rupture when inside a host; the periplasmic space is found between the peptidoglycan and the lipopolysaccharide layers of the cell wall in gram-negative organisms; and somatic antigens are found below the capsule.

OBJ: Level 1: Recall

25. The three basic shapes of bacteria include all the following, *except*
- a. spirochetes.
 - b. cell wall deficient.
 - c. cocci.
 - d. bacilli.

ANS: B

Cell wall deficient is not one of the basic shapes of bacteria. It refers to the cell wall composition, not the bacterial shape.

OBJ: Level 1: Recall

26. The Gram stain is a routine stain used in bacteriology to determine gram-positive and gram-negative bacteria based on the
- a. phenotypic characteristics of the organism.
 - b. composition of the bacterial cell wall.
 - c. composition of the bacterial cell membrane.
 - d. composition of the bacterial pili.

ANS: B

The composition of the bacterial cell wall is routinely used in bacteriology. The peptidoglycan cell walls of the gram-positive bacteria retain the crystal violet (purple) stain, whereas crystal violet stain is washed away because of the lipopolysaccharide (outer membrane) present in the cell walls of the gram-negative cells. The outer membrane retains the Safranin (pink) with the counter stain.

OBJ: Level 1: Recall

27. In what staining procedure does carbolfuchsin penetrate the bacterial cell wall through heat or detergent treatment?
- Gram stain
 - Acridine orange stain
 - Endospore stain
 - Acid-fast stain

ANS: D

Of all the stains listed, the acid-fast stain is the only one that requires heating or detergent treatment so that the carbolfuchsin stain can penetrate the waxy wall of acid-fast bacteria. Gram staining uses crystal violet stain; acridine orange is used in acridine orange stain; and the endospore stain uses malachite green.

OBJ: Level 1: Recall

28. What stain is used for medically important fungi?
- Methylene blue
 - Acridine orange
 - Acid-fast
 - Lactophenol cotton blue

ANS: D

Lactophenol cotton blue is the only fungi stain listed. Methylene blue is used to stain *Corynebacterium* spp.; acridine orange is used to stain all types of bacteria, living or dead; and acid-fast is used to stain *Mycobacterium* spp.

OBJ: Level 1: Recall

29. All the following are types of media, *except*
- selective.
 - differential.
 - fastidious.
 - transport.

ANS: C

Fastidious refers to the nutrient requirements of bacteria, not a type of media. Selective media have ingredients added to grow only selected bacteria. Differential media have chemicals added to allow visualization of metabolic differences of bacteria. Transport media are used to keep bacteria alive during transport to the laboratory.

OBJ: Level 1: Recall

30. Which of the following environmental factors influence the growth of bacteria in the laboratory?
- pH
 - Temperature
 - Gaseous composition of the atmosphere
 - All of the above

ANS: D

Most bacteria grow best at a pH between 7.0 and 7.5, at 35° C, with a requirement for the gaseous composition of the atmosphere. Some bacteria require higher than atmospheric moisture (humidity) levels for optimal growth (*Neisseria* sp.).

OBJ: Level 1: Recall

31. Some bacteria grow at 25° C or 42° C, but diagnostic laboratories routinely grow pathogenic bacteria at what temperature?
- 30° C
 - 60° C
 - 35° C
 - 10° C

ANS: C

Most pathogenic bacteria grow well at 35° C because it is close to body temperature; 30° C is the temperature at which most medically important fungi grow well; 60° C is too hot for pathogenic bacteria to grow, and 10° C is too cold for pathogenic bacteria to grow.

OBJ: Level 1: Recall

32. Which of these bacteria cannot grow in the presence of oxygen?
- Obligate aerobes
 - Capnophilic organisms
 - Facultative anaerobes
 - Obligate anaerobe

ANS: D

An obligate anaerobe is a bacterium that is killed when exposed to normal atmospheric conditions of oxygen and requires strict absence of oxygen. An obligate aerobe is a bacterium that grows only in the presence of oxygen, and a capnophilic bacterium grows only in the presence of 5% to 10% carbon dioxide.

OBJ: Level 1: Recall

33. What class of organisms, such as the *Streptococcus* sp., can survive in the presence of oxygen but do not use oxygen in its metabolic processes?
- Microaerophilic
 - Aerotolerant anaerobe
 - Obligate anaerobe
 - Facultative anaerobe

ANS: B

An aerotolerant anaerobe is one that can live in the presence of oxygen but does not use oxygen in its metabolic processes. A microaerophilic bacterium requires a reduced level of oxygen to grow. An obligate anaerobe cannot survive in the presence of oxygen, and a facultative anaerobe can grow either with or without oxygen.

OBJ: Level 1: Recall

34. The laboratory receives a specimen in which the doctor suspects that the infecting organism is *Haemophilus influenzae*. This organism grows best in an atmosphere that contains 5% to 10% carbon dioxide. It is therefore classified as what type of bacteria?
- Obligate aerobe
 - Capnophilic
 - Facultative anaerobe

d. Obligate anaerobe

ANS: B

Capnophilic bacteria need increased carbon dioxide in the atmosphere to grow; obligate aerobes can grow only in the presence of oxygen; facultative anaerobes can grow in the presence or absence of air; and obligate anaerobes need an atmosphere without oxygen to grow.

OBJ: Level 1: Recall

35. The following describes the log phase of bacterial growth:
- Preparing to divide
 - Limited nutrients with bacteria count remaining constant
 - Number of nonviable bacterial cells exceeds the number of viable cells
 - Bacteria doubling with each generation time

ANS: D

As a bacterium is immersed in an environment with favorable conditions for growth, the bacterium starts dividing; soon their numbers increase logarithmically. The growth tapers off as the nutrients become limited; then the bacteria will begin to die as the nutrients are exhausted.

OBJ: Level 1: Recall

36. Diagnostic schemes in the microbiology laboratory typically analyze each unknown bacterium's metabolic processes for all the following, *except*
- utilization of a variety of substrates as carbon sources.
 - energy utilization for metabolic processes.
 - production of specific end products from specific substrates.
 - production of an acid or alkaline pH in the test medium.

ANS: B

The microbiologist examines production of specific end products, production of an acid or alkaline pH in the test medium, and utilization of various carbon sources for energy to identify bacteria. Identification schemes are based on the percentages of bacterial species that exhibit particular metabolic processes in vitro.

OBJ: Level 1: Recall

37. Which is a biochemical process carried out by both obligate and facultative anaerobes?
- Fermentation
 - Respiration
 - Oxidation
 - Reduction

ANS: A

Fermentation takes place without oxygen. Respiration and oxidation need oxygen to occur. Reduction is a chemical reaction that can occur independent of bacteria.

OBJ: Level 1: Recall

38. What type of fermentation produces lactic, acetic, succinic, and formic acids as the end products?