EnterMedSchool.org

Prokaryotic Cells: Structure, Metabolism, and Comparison with Eukaryotes

Exam — Microbiology

Pre-med/IB-style MCQs on prokaryotic structure (cell envelope, nucleoid, plasmids, pili/flagella, ribosomes), prokaryotic metabolism (respiration, fermentation, photosynthesis, chemiosmosis), and high-yield comparisons with eukaryotic cells.

50 items — Printable Exam

Free & Open-Source

Generated February 20, 2026

Scan to visit online

1 **In a typical bacterial cell, the region containing most of the genetic material is called the:**

A Nucleus

B Nucleoid

C Nucleolus

D Rough endoplasmic reticulum

E Golgi apparatus

2 **Which statement about plasmids is most accurate?**

A They are membrane-bound organelles that store enzymes.

B They are usually small circular DNA molecules that can replicate independently of the bacterial chromosome.

C They contain all genes essential for bacterial survival.

D They are found only in eukaryotic cells.

E They are produced by ribosomes during translation.

3 **Why can some antibiotics inhibit bacterial protein synthesis without directly inhibiting human cytosolic ribosomes?**

A Human cytosolic ribosomes are 70S, while bacterial ribosomes are 80S.

B Bacterial ribosomes (70S) differ structurally from human cytosolic ribosomes (80S).

C Bacteria do not use ribosomes to make proteins.

D Antibiotics only bind DNA, not ribosomes.

E Human cells lack mRNA, so translation cannot be targeted.

4 **In many bacteria, translation can begin before transcription has finished. The best explanation is that bacteria:**

A Have mitochondria that export mRNA directly to ribosomes.

B Have no nucleus, so mRNA is accessible to ribosomes as it is synthesized.

C Use DNA polymerase to assemble amino acids.

D Require intron splicing before translation can start.

E Cannot regulate gene expression at the transcriptional level.

5 **The main advantage of an operon in bacteria is that it allows:**

A Genes on different chromosomes to be transcribed together.

B Several functionally related genes to be controlled by one promoter and transcribed as one mRNA.

C Proteins to be made without ribosomes.

D Introns to be removed from pre-mRNA.

E Mitosis to occur without a spindle.

6 **A bacterium placed in pure water is less likely to burst than an animal cell mainly because bacteria typically have:**

A A nucleus that controls water entry.

B A cell wall that resists osmotic swelling.

C Mitochondria that pump water out of the cell.

D Chloroplasts that remove excess water.

E No cytoplasm, so water cannot enter.

7 Which feature best distinguishes Gram-positive from Gram-negative bacteria?

A Gram-positive bacteria have an outer membrane containing LPS.

B Gram-negative bacteria have a thicker peptidoglycan layer.

C Gram-positive bacteria have a thick peptidoglycan cell wall and no outer membrane.

D Gram-positive bacteria lack a cell wall entirely.

E Gram-negative bacteria have no plasma membrane.

8 Which component is characteristic of the outer membrane of Gram-negative bacteria and contributes to a permeability barrier?

A Cellulose microfibrils

B Lipopolysaccharide (LPS)

C Chitin

D A thick peptidoglycan layer on the outside

E A nuclear envelope with pores

9 A bacterial capsule most directly helps the bacterium to:

A Carry out glycolysis.

B Avoid desiccation and/or evade immune defenses and aid adhesion.

C Package DNA into nucleosomes.

D Generate ATP via oxidative phosphorylation in mitochondria.

E Remove introns from mRNA.

10 Fimbriae/pili are most directly involved in:

A ATP synthesis by chemiosmosis.

B DNA replication at the origin.

C Attachment to surfaces and sometimes DNA transfer during conjugation.

D Protein folding in the endoplasmic reticulum.

E Formation of the nucleolus.

11 Bacterial flagella differ from eukaryotic flagella in that bacterial flagella typically:

A Contain a 9+2 microtubule arrangement.

B Rotate and are commonly powered by the proton motive force.

C Beat using dynein ATPase along microtubules.

D Are made of actin filaments.

E Function mainly in endocytosis.

12 A microtubule-disrupting drug stops a eukaryotic sperm from swimming but does not stop a motile bacterium. What is the best explanation?

A Bacterial flagella are microtubules, but they are drug-resistant.

B Bacterial motility uses flagellin-based rotating flagella, not microtubule-based bending.

C Bacteria cannot swim; any observed movement is diffusion only.

D Sperm use actin filaments for flagellar motion, not microtubules.

E Microtubules exist only in bacteria, not in eukaryotes.

13 Binary fission differs from mitosis because binary fission:

A Uses a spindle apparatus to separate chromosomes.

B Is division of a nucleus containing multiple linear chromosomes.

C Occurs in prokaryotes without a nucleus; a circular chromosome is replicated and partitioned as the cell constricts.

D Always produces four daughter cells.

E Is another name for meiosis I.

14 Which statement best compares chromosomal DNA replication in typical bacteria vs typical eukaryotes?

A Both typically have multiple replication origins per chromosome.

B Bacteria typically have one origin on a circular chromosome; eukaryotic linear chromosomes have many origins.

C Bacteria replicate DNA in the nucleus; eukaryotes replicate in the cytoplasm.

D Eukaryotes do not replicate DNA; they inherit it unchanged.

E Bacteria require telomerase to replicate chromosome ends.

15 **Which structure is absent from bacteria but present in typical animal cells?**

- A Plasma membrane
- B Ribosomes
- C Mitochondria
- D DNA
- E Cytoplasm

16 **In an aerobic bacterium, the electron transport chain for oxidative phosphorylation is primarily located in the:**

- A Nuclear envelope
- B Inner mitochondrial membrane
- C Plasma membrane
- D Golgi apparatus
- E Nucleoid

17 **In bacteria performing oxidative phosphorylation, ATP synthase is embedded in the:**

- A Cytosol as a free-floating enzyme complex
- B Plasma membrane
- C Cell wall
- D Nucleoid
- E Peroxisome membrane

18 **Glycolysis occurs in the:**

A Mitochondrial matrix only

B Cytoplasm of both prokaryotic and eukaryotic cells

C Nucleus only

D Golgi lumen

E Endoplasmic reticulum

19 **In a bacterium that uses the citric acid (Krebs) cycle, the enzymes of the cycle are found mainly in the:**

A Mitochondrial matrix

B Cytoplasm

C Nucleoid

D Periplasm

E Golgi apparatus

20 **A cell produces ATP without oxygen. Which statement correctly distinguishes fermentation from anaerobic respiration?**

A Fermentation uses an electron transport chain; anaerobic respiration does not.

B Fermentation uses an organic molecule as the final electron acceptor; anaerobic respiration uses an electron transport chain with a non-oxygen acceptor (e.g., nitrate).

C Fermentation occurs only in mitochondria; anaerobic respiration occurs only in chloroplasts.

D Anaerobic respiration produces no ATP at all.

E Fermentation and anaerobic respiration are identical terms.

21 Some bacteria can perform anaerobic respiration. What key feature makes this possible?

A They replace glycolysis with photosynthesis.

B They use a terminal electron acceptor other than O2 while maintaining an electron transport chain (e.g., nitrate).

C They stop using NAD^+/NADH entirely.

D They perform mitosis instead of binary fission.

E They import mitochondria from eukaryotic cells.

22 A bacterium oxidizes hydrogen sulfide (H2S) to obtain energy and uses CO2 as its carbon source. It is best described as a:

A Photoheterotroph

B Chemoautotroph (chemolithoautotroph)

C Photoautotroph

D Chemoheterotroph

E Obligate parasite

23 Which statement about cyanobacteria is correct?

A They are eukaryotes with chloroplasts.

B They carry out oxygenic photosynthesis using internal photosynthetic membranes and can release O2.

C They lack ribosomes and therefore cannot make proteins.

D They perform photosynthesis only in mitochondria.

E They cannot fix CO2 into organic molecules.

24 Which observation is strong evidence supporting the endosymbiotic origin of mitochondria?

A Mitochondria contain circular DNA and ribosomes similar in size to bacterial ribosomes.

B Mitochondria have cellulose cell walls.

C Mitochondria are only found in plants.

D Mitochondria perform glycolysis as their main function.

E Mitochondria are surrounded by a single membrane.

25 Which statement best distinguishes archaea from bacteria at the cell wall level?

A Archaea have peptidoglycan; bacteria do not.

B Bacteria have cellulose walls; archaea have chitin walls.

C Many archaea lack peptidoglycan and have different wall materials, while bacterial walls typically contain peptidoglycan.

D Archaea have no cell membrane.

E Archaea have a nucleus, while bacteria do not.

26 **A microorganism is found to have ether-linked membrane lipids with branched hydrocarbon chains. This finding most strongly suggests it is a(n):**

A Gram-positive bacterium

B Archaeon

C Animal cell

D Fungal cell

E Plant cell with chloroplasts

27 **Which statement about DNA packaging is most accurate?**

A Bacterial DNA is wrapped around the same histones as eukaryotic nuclear DNA.

B Eukaryotic nuclear DNA is packaged with histones into chromatin; bacteria use different DNA-binding proteins and do not form typical nucleosomes.

C Neither bacteria nor eukaryotes use proteins with DNA.

D Only bacteria have histones.

E Histones are found only in mitochondria.

28 **A key reason bacterial translation can start quickly after transcription begins is that bacterial mRNA typically:**

A Must be spliced and capped in the nucleus before leaving.

B Is not separated from ribosomes by a nuclear envelope and usually undergoes minimal processing compared with eukaryotic mRNA.

C Is always stored for hours before translation.

D Contains telomeres at both ends.

E Is translated only on rough ER.

29 **In bacteria, a single mRNA often encodes multiple proteins mainly because bacterial genes are commonly organized into:**

A Introns

B Operons producing polycistronic mRNA

C Telomeres

D Chromatin loops

E Nuclear pores

30 **Why can bacteria often adjust protein production rapidly when the environment changes (e.g., sudden appearance of lactose)?**

A They can perform mitosis in seconds.

B Transcription and translation are coupled and mRNA is often short-lived, so changing transcription quickly changes protein output.

C They store large amounts of pre-made mRNA inside the nucleus.

D They lack gene regulation, so proteins are always made at maximum rate.

E They have chloroplasts that regulate gene expression.

31 **Which process is correctly matched with its description?**

A Conjugation — DNA transfer mediated by a bacteriophage

B Transformation — DNA transfer by direct cell-to-cell contact

C Transduction — uptake of naked DNA from the environment

D Transduction — DNA transfer mediated by a virus (bacteriophage)

E Binary fission — exchange of plasmids between cells

32 **A bacterium takes up a free DNA fragment from its surroundings and incorporates it into its genome. This is called:**

A Conjugation

B Transduction

C Transformation

D Binary fission

E Mitosis

33 **During conjugation, antibiotic resistance can spread rapidly mainly because:**

A Resistance proteins diffuse directly into neighboring cells.

B Plasmids carrying resistance genes can be transferred directly between cells.

C Bacteria reproduce by meiosis, creating resistance gametes.

D Antibiotics cause directed mutations toward resistance.

E Ribosomes copy antibiotic genes into DNA.

34 **Penicillin inhibits peptidoglycan cross-linking. Human cells are not directly affected mainly because human cells:**

A Lack ribosomes.

B Lack peptidoglycan cell walls.

C Have circular chromosomes.

D Cannot synthesize proteins.

E Use different genetic codes.

35 An antibiotic binds the 30S ribosomal subunit. What process is most directly inhibited?

A DNA replication in a nucleus

B Bacterial protein synthesis (translation)

C Peptidoglycan cross-linking

D Spindle formation during mitosis

E Chlorophyll absorption of light

36 Mycoplasma species lack a cell wall. Which consequence follows most directly?

A They are unaffected by antibiotics that target peptidoglycan synthesis.

B They cannot have a plasma membrane.

C They cannot replicate DNA.

D They must be Gram-positive because they lack an outer membrane.

E They must contain mitochondria to survive.

37 Bacterial endospores are best described as:

A Reproductive gametes that increase population size.

B Dormant, highly resistant structures formed for survival under harsh conditions.

C Membrane-bound organelles where respiration occurs.

D Small circular DNAs that carry antibiotic resistance.

E Structures that perform photosynthesis in bacteria.

38 **Compared with typical eukaryotic cells, many bacteria have a higher surface area-to-volume ratio. A key advantage is that bacteria can:**

A Perform mitosis more accurately.

B Exchange nutrients and wastes efficiently by diffusion across the membrane.

C Avoid mutation due to small size.

D Store more DNA per cell without any limits.

E Use mitochondria more effectively.

39 **One reason many eukaryotic cells benefit from membrane-bound organelles while prokaryotes generally do not is that eukaryotic cells are typically larger, so organelles:**

A Make surface area-to-volume ratio larger by removing membrane.

B Create specialized compartments that increase efficiency and allow incompatible reactions to occur simultaneously.

C Prevent DNA replication so the cell can grow.

D Are required for binary fission to occur.

E Replace ribosomes in protein synthesis.

40 **Which statement about cytoskeleton is most accurate?**

A Prokaryotes have no cytoskeleton proteins at all.

B Prokaryotes have cytoskeletal proteins (e.g., FtsZ, MreB) that help with cell shape and division, though the system is simpler than in eukaryotes.

C Prokaryotes have 9+2 microtubules in all cells.

D Only eukaryotes can form any kind of division ring.

E Cytoskeleton functions only in movement, not division or shape.

41 **A protein that forms a ring at the future site of bacterial cell division and helps recruit the division machinery is:**

A Tubulin

B FtsZ

C Dynein

D Kinesin

E Collagen

42 **The periplasmic space (a defined space between two membranes) is most associated with:**

A Gram-positive bacteria only

B Gram-negative bacteria, between the inner membrane and outer membrane

C All animal cells, between nucleus and mitochondria

D Viruses, between capsid and genome

E Chloroplasts, between thylakoids and stroma

43 **A lab separates ribosomes by sedimentation coefficient. Which pairing is correct?**

A Bacteria: 80S; Eukaryotic cytosol: 70S

B Bacteria: 70S; Eukaryotic cytosol: 80S

C Both bacteria and eukaryotic cytosol: 70S

D Both bacteria and eukaryotic cytosol: 80S

E Bacteria: 60S; Eukaryotic cytosol: 40S

44 **Which statement best describes typical chromosome organization in bacteria vs eukaryotes?**

A Bacteria typically have multiple linear chromosomes with telomeres; eukaryotes have one circular chromosome.

B Bacteria typically have a single circular chromosome; eukaryotes typically have multiple linear chromosomes.

C Both bacteria and eukaryotes always have circular chromosomes.

D Both bacteria and eukaryotes always have linear chromosomes.

E Bacteria store their DNA in a membrane-bound nucleus.

45 **In typical eukaryotic cells, transcription and translation are separated in space primarily because:**

A Ribosomes cannot exist in the cytoplasm.

B The nuclear envelope separates DNA transcription in the nucleus from translation on cytosolic ribosomes.

C Eukaryotes do not use mRNA for protein synthesis.

D Translation occurs inside mitochondria only.

E Eukaryotes lack RNA polymerase.

46 Which option correctly matches major groups to their typical cell wall structural polymer?

A Bacteria: cellulose; Plants: peptidoglycan; Fungi: chitin

B Bacteria: peptidoglycan; Plants: cellulose; Fungi: chitin

C Bacteria: chitin; Plants: cellulose; Fungi: peptidoglycan

D Bacteria: peptidoglycan; Plants: chitin; Fungi: cellulose

E Bacteria: none; Plants: peptidoglycan; Fungi: cellulose

47 Bacterial ribosomes are described as "70S" and their subunits as "50S" and "30S". What does the "S" most directly represent?

A The number of protein subunits in the ribosome

B A size unit in nanometers that adds directly (30 + 50 always equals 80)

C A sedimentation coefficient (how fast particles sediment), which is not strictly additive

D The number of amino acids the ribosome can hold

E A measurement of ATP required for translation

48 A key difference in translation initiation between bacteria and eukaryotic cytosol is that bacteria typically:

A Use 5 cap-dependent scanning from the mRNA cap to find the start codon

B Use a ribosome-binding sequence (e.g., Shine–Dalgarno) to align the ribosome near the start codon

C Initiate translation only inside the nucleus

D Require intron removal before ribosomes can bind

E Use mitochondria to attach ribosomes to mRNA

49 **Some bacteria perform photosynthesis without producing oxygen. Which explanation best accounts for this?**

A They use CO2 as the electron donor and release oxygen as waste.

B They use water as the electron donor but do not release oxygen.

C They use an electron donor other than water (e.g., H2S), so O2 is not produced.

D They have no electron transport chain, so photosynthesis produces no by-products.

E They lack pigments, so photosynthesis is impossible.

50 **In many bacteria, the proton motive force across the plasma membrane can directly power which process besides ATP synthesis?**

A DNA replication by DNA polymerase

B Ribosome assembly from rRNA and proteins

C Flagellar rotation and some forms of active transport (symport/antiport)

D Formation of the nuclear envelope

E Splicing introns out of mRNA

#	Ans	Answer Text
1	B	Nucleoid
2	B	They are usually small circular DNA molecules that can replicate indepen...
3	B	Bacterial ribosomes (70S) differ structurally from human cytosolic ribos...
4	B	Have no nucleus, so mRNA is accessible to ribosomes as it is synthesized...
5	B	Several functionally related genes to be controlled by one promoter and ...
6	B	A cell wall that resists osmotic swelling.
7	C	Gram-positive bacteria have a thick peptidoglycan cell wall and no outer...
8	B	Lipopolysaccharide (LPS)
9	B	Avoid desiccation and/or evade immune defenses and aid adhesion.
10	C	Attachment to surfaces and sometimes DNA transfer during conjugation.
11	B	Rotate and are commonly powered by the proton motive force.
12	B	Bacterial motility uses flagellin-based rotating flagella, not microtubu...
13	C	Occurs in prokaryotes without a nucleus; a circular chromosome is replic...
14	B	Bacteria typically have one origin on a circular chromosome; eukaryotic ...
15	C	Mitochondria
16	C	Plasma membrane
17	B	Plasma membrane
18	B	Cytoplasm of both prokaryotic and eukaryotic cells
19	B	Cytoplasm
20	B	Fermentation uses an organic molecule as the final electron acceptor; an...
21	B	They use a terminal electron acceptor other than O2 while maintaining an...
22	B	Chemoautotroph (chemolithoautotroph)
23	B	They carry out oxygenic photosynthesis using internal photosynthetic mem...
24	A	Mitochondria contain circular DNA and ribosomes similar in size to bacte...
25	C	Many archaea lack peptidoglycan and have different wall materials, while...
26	B	Archaeon
27	B	Eukaryotic nuclear DNA is packaged with histones into chromatin; bacteri...
28	B	Is not separated from ribosomes by a nuclear envelope and usually underg...
29	B	Operons producing polycistronic mRNA
30	B	Transcription and translation are coupled and mRNA is often short-lived,...
31	D	Transduction — DNA transfer mediated by a virus (bacteriophage)
32	C	Transformation
33	B	Plasmids carrying resistance genes can be transferred directly between c...
34	B	Lack peptidoglycan cell walls.
35	B	Bacterial protein synthesis (translation)
36	A	They are unaffected by antibiotics that target peptidoglycan synthesis.
37	B	Dormant, highly resistant structures formed for survival under harsh con...
38		Exchange nutrients and wastes efficiently by diffusion across the membra...