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Prokaryotic Cells: Structure, Metabolism, and Comparison with Eukaryotes

Study Guide — 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 — Study Guide with Answers

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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

▶ **Explanation:** Bacteria lack a membrane-bound nucleus. Their chromosome occupies a dense region called the nucleoid; nucleolus/ER/Golgi are eukaryotic structures.

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.

▶ **Explanation:** Plasmids are extra-chromosomal DNA, often circular, and may carry useful but non-essential genes (e.g., antibiotic resistance). They are not organelles and are not made by ribosomes.

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.

▶ **Explanation:** Many antibiotics target features of 70S ribosomes found in bacteria, while human cytosolic ribosomes are 80S. A common trap: mitochondria have ribosomes more similar to bacteria, which helps explain some side effects.

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.

▶ **Explanation:** Because bacteria lack a nuclear envelope, transcription and translation occur in the same compartment, allowing coupling. Mitochondria and intron splicing are eukaryotic-focused distractors.

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.

▶ **Explanation:** Operons coordinate expression of multiple genes involved in the same pathway by using shared regulatory DNA (one promoter/operator). Splicing and mitosis are not relevant to typical bacterial gene organization.

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.

▶ **Explanation:** In hypotonic conditions water enters cells by osmosis. The bacterial cell wall (peptidoglycan in most bacteria) provides mechanical strength against lysis; animal cells lack cell walls.

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.

▶ **Explanation:** Gram-positive bacteria typically have thick peptidoglycan and no outer membrane; Gram-negative bacteria have thin peptidoglycan plus an outer 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

▶ **Explanation:** Gram-negative bacteria have an outer membrane containing LPS and porins. Cellulose and chitin are typical of plants and fungi, and nuclei are eukaryotic.

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.

▶ **Explanation:** Capsules (glycocalyx) can protect against drying, help bacteria stick to surfaces, and reduce immune recognition. DNA packaging into nucleosomes and mRNA splicing are eukaryotic distractors.

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.

▶ **Explanation:** Pili/fimbriae are surface structures used for adhesion; specialized sex pili help transfer plasmids during conjugation. ER and nucleolus are eukaryotic structures.

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.

▶ **Explanation:** Bacterial flagella are rotary motors (often powered by H^+ flow). Eukaryotic flagella/cilia use microtubules (9+2) and dynein powered by ATP.

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.

▶ **Explanation:** Eukaryotic flagella depend on microtubules and dynein, so microtubule disruption halts movement. Bacterial flagella are built from different proteins and rotate rather than bend via microtubules.

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.

▶ **Explanation:** Binary fission is prokaryotic cell division without mitotic spindles or a nucleus. Mitosis is eukaryotic nuclear division involving a spindle and typically linear chromosomes.

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.

▶ **Explanation:** A typical bacterial chromosome has a single origin of replication; eukaryotic chromosomes are larger and usually use many origins. Telomerase is associated with eukaryotic linear chromosome ends, not typical bacterial circular chromosomes.

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

A Plasma membrane

B Ribosomes

C **Mitochondria** ✓

D DNA

E Cytoplasm

▶ **Explanation:** Bacteria have membranes, ribosomes, cytoplasm, and DNA, but lack membrane-bound organelles such as mitochondria.

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

▶ **Explanation:** Bacteria lack mitochondria, so their respiratory electron transport chain is embedded in the plasma membrane, which is where they establish a proton gradient.

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

▶ **Explanation:** ATP synthase must sit in a membrane to use an ion gradient (chemiosmosis). In bacteria that gradient is across the plasma membrane, not mitochondrial or peroxisomal membranes.

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

▶ **Explanation:** Glycolysis is a cytosolic pathway in both prokaryotes and eukaryotes. Mitochondria become involved later (e.g., pyruvate oxidation/ETC) in aerobic eukaryotes.

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

▶ **Explanation:** Bacteria lack mitochondria, so TCA cycle enzymes are in the cytosol (while the ETC is in the plasma membrane).

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.

▶ **Explanation:** Fermentation regenerates NAD^+ by reducing an organic molecule (like pyruvate) and does not use an ETC. Anaerobic respiration still uses an ETC, but uses a terminal electron acceptor other than O2 (often inorganic).

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.

▶ **Explanation:** Anaerobic respiration still relies on an ETC and chemiosmosis, but uses an alternative final electron acceptor (like nitrate or sulfate) when oxygen is absent.

22 A bacterium oxidizes hydrogen sulfide (H_2S) to obtain energy and uses CO_2 as its carbon source. It is best described as a:

A Photoheterotroph

B **Chemoautotroph (chemolithoautotroph)** ✓

C Photoautotroph

D Chemoheterotroph

E Obligate parasite

▶ **Explanation:** Energy from inorganic chemicals (H_2S) = chemo(litho)-. Carbon from CO_2 = autotroph. Photo- would require light; heterotroph would require organic carbon.

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 O_2.** ✓

C They lack ribosomes and therefore cannot make proteins.

D They perform photosynthesis only in mitochondria.

E They cannot fix CO_2 into organic molecules.

▶ **Explanation:** Cyanobacteria are prokaryotes that perform oxygenic photosynthesis (water as electron donor → O2 released) using internal membranes (thylakoid-like). They still have ribosomes and can fix CO2.

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.

▶ **Explanation:** Mitochondria show bacterial-like traits (circular DNA, 70S-like ribosomes, division resembling fission, double membrane), supporting an origin from an ancestral prokaryote living inside another cell.

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.

▶ **Explanation:** Peptidoglycan is characteristic of bacterial walls. Archaea often have different wall components (e.g., pseudopeptidoglycan or protein S-layers) and still have membranes; neither group has a nucleus.

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

▶ **Explanation:** Archaeal membranes commonly use ether linkages and branched isoprenoid chains. Bacteria and eukaryotes typically have ester-linked fatty acids (with important exceptions, but the pattern is a classic archaeal signature).

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.

▶ **Explanation:** Eukaryotic DNA forms chromatin with histones (nucleosomes). Bacteria compact DNA with supercoiling and histone-like proteins, but not the same nucleosome-based structure typical of eukaryotic nuclei.

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.

▶ **Explanation:** Bacteria lack a nucleus, so mRNA can be translated while it's being transcribed. They also typically do not require the extensive mRNA processing seen in eukaryotes (capping, splicing, export).

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

▶ **Explanation:** Operons allow multiple coding sequences to be transcribed together into one polycistronic mRNA. Introns/telomeres/nuclear structures are not the main bacterial strategy for multi-gene coordination.

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.

▶ **Explanation:** Coupling means new mRNA can be translated almost immediately. Many bacterial mRNAs degrade quickly, so turning genes on/off produces a fast change in protein levels.

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

▶ **Explanation:** Transduction is virus-mediated DNA transfer. Transformation is uptake of free DNA; conjugation is direct transfer between cells (often via a pilus). Binary fission is asexual division, not gene exchange.

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

▶ **Explanation:** Transformation is the uptake of naked DNA from the environment. Conjugation requires cell-to-cell contact; transduction uses a bacteriophage.

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.

▶ **Explanation:** Conjugation can transfer plasmids that already carry resistance genes, increasing their spread without waiting for new mutations. Proteins do not serve as the inherited genetic material.

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.

▶ **Explanation:** Penicillin targets bacterial cell wall synthesis. Human (animal) cells do not have peptidoglycan walls, so this specific target is absent.

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

▶ **Explanation:** 30S is part of the bacterial 70S ribosome (30S + 50S). Binding it disrupts translation. Peptidoglycan synthesis and mitotic spindles are unrelated targets.

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.

▶ **Explanation:** If there is no peptidoglycan wall, drugs targeting peptidoglycan synthesis have no direct target. A plasma membrane is still essential for any cell, and mitochondria are not required for prokaryotes.

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.

▶ **Explanation:** Endospores are survival forms (e.g., in Bacillus/Clostridium) that resist heat/desiccation/chemicals. They are not for reproduction and are not organelles or plasmids.

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.

▶ **Explanation:** High SA:V helps diffusion-based exchange (nutrients/waste) happen efficiently, supporting rapid growth. Mitosis and mitochondria are eukaryotic concepts.

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.

▶ **Explanation:** Compartmentalization localizes enzymes/substrates and separates processes (e.g., lysosomal digestion vs cytosolic metabolism). Prokaryotes often rely on the plasma membrane and cytosol instead of internal organelles.

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.

▶ **Explanation:** A common trap is thinking prokaryotes lack cytoskeleton completely. They do have key cytoskeletal proteins that organize shape and division, even though they lack the full eukaryotic microtubule/actin/dynein machinery.

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

▶ **Explanation:** FtsZ is a bacterial cytoskeletal protein (tubulin-like) that forms the Z-ring, guiding septum formation during binary fission. Dynein/kinesin are eukaryotic motor proteins; collagen is extracellular matrix in animals.

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

▶ **Explanation:** Gram-negative bacteria have two membranes, creating a periplasm where a thin peptidoglycan layer and many enzymes reside. Gram-positive bacteria lack an outer membrane.

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

▶ **Explanation:** Bacterial ribosomes are 70S (50S+30S), while eukaryotic cytosolic ribosomes are 80S (60S+40S). The 60S and 40S values are eukaryotic subunits, not whole ribosomes.

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.

▶ **Explanation:** A classic comparison is single circular bacterial chromosomes vs multiple linear eukaryotic chromosomes. There are exceptions (some bacteria have multiple chromosomes; some organelles have circular DNA), but the general pattern is high-yield.

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.

▶ **Explanation:** Eukaryotic DNA is inside a nucleus. mRNA is transcribed in the nucleus and exported to the cytoplasm for translation, unlike bacteria where both processes can be coupled.

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

▶ **Explanation:** Peptidoglycan is characteristic of bacterial cell walls, cellulose of plant walls, and chitin of fungal walls. A common trap is mixing these polymers across kingdoms.

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

▶ **Explanation:** "S" (Svedberg unit) measures sedimentation rate during centrifugation and depends on size/shape/density, so it is not strictly additive. That's why 30S + 50S gives 70S, not 80S.

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

▶ **Explanation:** Bacterial mRNAs typically contain a ribosome-binding site that positions the ribosome at the start codon. Eukaryotic cytosolic translation commonly involves 5 cap recognition and scanning (with many details beyond this level).

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.

▶ **Explanation:** Oxygenic photosynthesis produces O2 specifically because water is split to supply electrons. In anoxygenic photosynthesis, other electron donors (like H2S) are used, so oxygen is not released.

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

▶ **Explanation:** A proton gradient can do work: it can drive ATP synthase, power bacterial flagellar motors, and energize transporters. Nuclear envelopes and intron splicing are eukaryotic processes.