

Name: _____ Date: _____

Answer Key: Neon Micro-Metabolism: 10th Grade Bio-Engineers Quiz

Synthesize knowledge of metabolic diversity and horizontal gene transfer across 10 rigorous challenges designed for the next generation of microbiologists.

1. A strain of Halobacterium is found thriving in a high-salinity environment, utilizing bacteriorhodopsin to drive ATP synthesis without a standard electron transport chain. How should this organism be classified metabolically?

Answer: B) Photoheterotroph

Photoheterotrophs use light for energy (via bacteriorhodopsin) but cannot use CO₂ as their sole carbon source, requiring organic compounds from their environment.

2. In the process of _____, a bacteriophage acts as a vector, accidentally packaging bacterial DNA and transferring it to a new host cell, contributing to genetic recombination.

Answer: C) Transduction

Transduction is specifically the viral-mediated transfer of genetic material between bacteria, distinct from direct contact (conjugation) or environmental uptake (transformation).

3. Gram-negative bacteria possess a thick peptidoglycan layer that traps crystal violet stain, whereas Gram-positive bacteria have a thin layer and an outer lipopolysaccharide membrane.

Answer: B) False

This is false; the descriptions are swapped. Gram-positive bacteria have the thick peptidoglycan layer, while Gram-negative bacteria have the thin layer and outer membrane.

4. Considering the Endosymbiotic Theory, which evidence best supports the claim that mitochondria evolved from proteobacteria rather than being synthesized de novo by the eukaryotic host?

Answer: C) Mitochondrial ribosomes resemble 70S bacterial ribosomes

The presence of 70S ribosomes and circular DNA within mitochondria provides strong phylogenetic evidence of their bacterial origins.

5. When a population of microbes reaches a critical density, they coordinate gene expression via _____, allowing the colony to act as a multicellular unit to form biofilms or release toxins.

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Answer: B) Quorum Sensing

Quorum sensing involves the production and detection of autoinducers to regulate collective behavior based on population density.

6. Retroviruses, such as HIV, utilize the enzyme reverse transcriptase to integrate their RNA genome into the host's DNA as a provirus.

Answer: A) True

True. Reverse transcriptase synthesizes DNA from an RNA template, a process central to the retroviral life cycle.

7. A researcher observes a microbe reducing nitrate (NO₃⁻) to nitrogen gas (N₂) in an oxygen-depleted environment. This metabolic pathway is best identified as:

Answer: C) Anaerobic Respiration

Anaerobic respiration uses inorganic molecules other than oxygen (like nitrate) as the final electron acceptor in the electron transport chain.

8. The extremely resilient structure formed by certain bacteria like Bacillus anthracis to survive high temperatures and desiccation is called a(n) _____.

Answer: B) Endospore

Endospores are dormant, tough, and non-reproductive structures produced by a small number of bacteria from the Firmicute phylum to ensure survival through periods of environmental stress.

9. Prions are infectious agents composed entirely of misfolded proteins that lack any nucleic acids.

Answer: A) True

True. Unlike viruses or bacteria, prions do not contain DNA or RNA; they induce normal proteins in the brain to fold abnormally.

10. In the context of the Lysogenic Cycle, what characterizes the 'prophage' stage of a viral infection?

Answer: C) The viral DNA being integrated into the host's bacterial chromosome

During the lysogenic cycle, the viral genome is integrated into the host's DNA (becoming a prophage) and is replicated along with the host's genome without killing the cell.