Name: _____ **Date:** _____

Answer Key: Extremophiles vs Pathogens: 12th Grade Microbiology Challenge

Can microscopic life thrive in boiling vents or survive antibiotic onslaughts? Analyze metabolic pathways and structural adaptations in diverse prokaryotes.

---

1. The bacterial cell wall component peptidoglycan is targeted by beta-lactam antibiotics. Which organism would be naturally resistant to these drugs due to a lack of this specific polymer?

Answer: C) Mycoplasma pneumoniae

Mycoplasma species are unique among bacteria because they lack a cell wall entirely, making them intrinsically resistant to antibiotics like penicillin that inhibit cell wall synthesis.

2. 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

Reverse transcriptase catalyzes the transcription of RNA into DNA, which is a critical step for retroviral replication and long-term integration into host chromosomes.

3. In the nitrogen cycle, the process of converting atmospheric N2 into ammonia (NH3) is primarily performed by specialized bacteria using the enzyme _____.

Answer: A) Nitrogenase

Nitrogenase is the complex enzyme system used by diazotrophs (like Rhizobium) to break the triple bond of N2 gas, an essential process for global nutrient cycling.

4. Which mechanism of horizontal gene transfer involves the uptake of 'naked' DNA fragments from the surrounding environment by a competent bacterial cell?

Answer: D) Transformation

Transformation is the process where bacteria take up extracellular DNA, often released by dead cells, which can then be incorporated into their own genome.

5. Prions are infectious agents composed entirely of misfolded proteins and contain no nucleic acids (DNA or RNA).

Name: _____ **Date:** _____

Answer: A) True

Unlike viruses or bacteria, prions achieve infectivity by inducing normal cellular proteins to fold into the same abnormal, disease-causing shape.

6. Archaea found in high-salinity environments, such as the Dead Sea, are specifically classified as _____.

Answer: B) Extreme Halophiles

Halophiles are organisms that thrive in high salt concentrations; 'extreme' halophiles require salinity levels significantly higher than those found in the ocean.

7. When performing a Gram stain, what is the primary structural reason why Gram-negative bacteria appear pink/red rather than purple?

Answer: C) The thin peptidoglycan layer loses the crystal violet complex during decolorization.

Gram-negative bacteria have a thin peptidoglycan layer and an outer membrane; the alcohol wash disrupts the outer membrane and washes away the crystal violet, allowing the counterstain (safranin) to show.

8. Agrobacterium tumefaciens is frequently used in biotechnology to create transgenic plants because of its ability to transfer its _____ into the host plant's genome.

Answer: B) Ti Plasmid

The Tumor-Inducing (Ti) plasmid naturally transfers a segment of DNA (T-DNA) into plant cells, making it an ideal vector for genetic engineering.

9. The Theory of Endosymbiosis suggests that mitochondria and chloroplasts originated as free-living prokaryotes that were engulfed by an ancestral eukaryotic cell.

Answer: A) True

Evidence such as double membranes, circular DNA, and 70S ribosomes within these organelles supports the endosymbiotic origin theory.

10. During the lysogenic cycle of a bacteriophage, what is the state of the viral DNA?

Answer: C) It is integrated into the bacterial chromosome as a prophage.

In the lysogenic cycle, the viral genome is integrated into the host DNA and replicated along with it, remaining latent until environmental triggers initiate the lytic cycle.

Name: _____ Date: _____