Name: _____ **Date:** _____

Answer Key: The Last of Us: Advanced Microbiology Survival Quiz for 12th Grade

Synthesize data on metabolic pathways and horizontal gene transfer to stop a hypothetical pandemic. This format forces deep analysis of microbial tactics.

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1. An environmental isolate shows the ability to thrive in extremely high concentrations of arsenic by utilizing a periplasmic arsenite oxidase. What evolutionary mechanism most likely allowed for the rapid acquisition of this specialized metabolic trait in a previously sensitive population?

Answer: B) Horizontal gene transfer via an R-plasmid

Horizontal gene transfer (HGT), specifically via plasmids, allows bacteria to share niche-specific resistance genes quickly across a population, bypassing the slower process of random mutation.

2. Retroviruses, such as HIV, utilize a high-fidelity DNA polymerase to ensure genomic stability during the integration process into the host genome.

Answer: B) False

Retroviruses use reverse transcriptase, which lacks proofreading capabilities (low fidelity), leading to high mutation rates that help the virus evade the immune system.

3. In the presence of both glucose and lactose, E. coli will prioritize glucose metabolism through a process called catabolite repression, which is mediated by the signaling molecule _____.

Answer: C) cAMP

Cyclic AMP (cAMP) levels are inversely proportional to glucose levels; it binds to the Catabolite Activator Protein (CAP) to stimulate the transcription of alternative sugar operons.

4. You are treating a patient with a suspected Mycoplasma pneumoniae infection. Why would prescribing a Beta-lactam antibiotic, such as Penicillin, be an example of poor clinical judgment?

Answer: B) Mycoplasma naturally lack a cell wall, the target of Beta-lactams

Beta-lactam antibiotics inhibit cell wall synthesis by targeting transpeptidase. Mycoplasma species are unique among bacteria because they lack a cell wall entirely, making them intrinsically resistant.

5. Archaeal membranes differ significantly from bacterial membranes because they contain _____ linkages connecting glycerol to isoprenoid chains, allowing for greater stability in extreme heat.

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Answer: C) Ether

Archaea utilize ether-linked lipids (often branched isoprenoids), which are chemically more resistant to hydrolysis and heat than the ester-linked fatty acids found in Bacteria and Eukarya.

6. In Quorum Sensing, bacteria release autoinducers that only trigger a response once a specific population density threshold is reached.

Answer: A) True

Quorum sensing is a density-dependent mechanism where the concentration of signaling molecules (autoinducers) allows a population to coordinate gene expression (like biofilm formation or virulence).

7. An obligated anaerobic bacterium is placed in a high-oxygen environment. Death occurs because the microbe lacks which specific set of neutralized enzymes?

Answer: B) Superoxide Dismutase (SOD) and Catalase

Obligate anaerobes lack enzymes like SOD and Catalase, which neutralize Reactive Oxygen Species (ROS). Without these, oxygen byproducts cause lethal oxidative damage to cellular components.

8. During the lysogenic cycle of a bacteriophage, the viral genome is integrated into the bacterial chromosome and is referred to as a _____.

Answer: B) Prophage

A prophage is the latent form of a bacteriophage genome within the host's chromosome, capable of being replicated alongside host DNA until induction into the lytic cycle.

9. Endospores are reproductive structures produced by fungi to survive harsh environmental conditions such as extreme desiccation.

Answer: B) False

Endospores are survival structures (not primarily reproductive) produced by certain Gram-positive bacteria (e.g., Bacillus and Clostridium); fungi produce spores that serve both survival and reproductive roles but are not called 'endospores.'

10. How does the CRISPR-Cas9 system function naturally in prokaryotic cells?

Answer: B) As an adaptive immune system against viral DNA

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CRISPR-Cas9 is a microbial defense mechanism that captures snippets of viral DNA (spacers) to recognize and cleave matching sequences during subsequent infections.