Name: _____ **Date:** _____

Answer Key: Metabolic Flux & Microbial Genetics: Your 12th Grade Mastery Quiz

Students synthesize knowledge of horizontal gene transfer and metabolic pathways to predict microbial behavior in complex environmental and clinical scenarios.

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1. In the context of the lac operon in E. coli, what is the phenotypic consequence of a loss-of-function mutation in the lacI gene when glucose is absent but lactose is also absent?

Answer: B) Constitutive expression of the structural genes occurs because the repressor cannot bind the operator.

The lacI gene codes for the repressor protein; if it is non-functional, it cannot bind to the operator to block RNA polymerase, leading to constitutive (continuous) expression regardless of lactose presence.

2. The process by which a bacteriophage accidentally packages bacterial chromosomal DNA and transfers it to a recipient cell is known as _____.

Answer: A) Generalized transduction

Generalized transduction occurs during the lytic cycle when random fragments of the host genome are packaged into the viral capsid instead of the viral genome.

3. Archaea are physiologically identical to Bacteria because both utilize 70S ribosomes and lack a membrane-bound nucleus.

Answer: B) False

While both are prokaryotic, Archaea possess unique membrane ethers, lack peptidoglycan, and have transcription machinery more closely resembling Eukaryotes.

4. Which transition in the nitrogen cycle is performed exclusively by diazotrophs like Rhizobium using the nitrogenase enzyme complex?

Answer: C) N_2 to NH_3 (Nitrogen Fixation)

Nitrogen fixation is the biological reduction of atmospheric N_2 to ammonia, a process sensitive to oxygen and requiring the specialized nitrogenase enzyme.

5. In extreme environments, some microorganisms use _____ as a terminal electron acceptor in anaerobic respiration, a process common in deep-sea hydrothermal vents.

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Answer: B) Elemental Sulfur

Many extremophiles, particularly sulfur-reducing archaea, utilize elemental sulfur or sulfate as electron acceptors when oxygen is unavailable.

6. The use of 'quorum sensing' allows bacterial populations to coordinate gene expression based on local cell density through the secretion of autoinducers.

Answer: A) True

Quorum sensing is a chemical communication system that triggers collective behaviors like biofilm formation or virulence once a critical population threshold is reached.

7. When analyzing a viral growth curve in a laboratory setting, the 'eclipse period' refers to the timeframe when:

Answer: B) Infectious virions cannot be detected because they have uncoated and are replicating internally.

During the eclipse phase, the virus has entered the cell and disassembled; individual components are being synthesized but have not yet been assembled into mature, detectable virions.

8. Prions are unique among infectious agents because they lack _____ and propagate by inducing misfolding in normal cellular proteins.

Answer: B) Nucleic acids

Unlike viruses or bacteria, prions are strictly proteinaceous and do not contain DNA or RNA, challenging the traditional central dogma of molecular biology in pathology.

9. In Gram-negative bacteria, the 'O antigen' is a component of the lipopolysaccharide (LPS) layer associated with the outer membrane.

Answer: A) True

LPS consists of Lipid A, a core polysaccharide, and the O antigen, which is often used for serotyping different strains of bacteria like E. coli.

10. An obligate anaerobe is exposed to an environment with 21% oxygen. Why does this organism likely perish?

Answer: A) It lacks enzymes like superoxide dismutase and catalase to neutralize reactive oxygen species (ROS).

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Obligate anaerobes lack the necessary antioxidant enzymes to process the toxic byproducts of oxygen metabolism, such as superoxide radicals and hydrogen peroxide.