

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## 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?**

- A. The operon remains repressed due to catabolite activator protein (CAP) inactivity.
- B. Constitutive expression of the structural genes occurs because the repressor cannot bind the operator.
- C. Transcription is inhibited by the presence of high cAMP levels.
- D. The promoter undergoes methylation, silencing the entire metabolic pathway.

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

- A. Generalized transduction
- B. Specialized conjugation
- C. Natural transformation
- D. Horizontal transposition

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

- A. True
- B. False

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

- A.  $\text{NO}_3^-$  to  $\text{N}_2$  (Denitrification)
- B.  $\text{NH}_4^+$  to  $\text{NO}_2^-$  (Nitrification)
- C.  $\text{N}_2$  to  $\text{NH}_3$  (Nitrogen Fixation)
- D. Organic N to  $\text{NH}_4^+$  (Ammonification)

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

- A. Molecular Oxygen
- B. Elemental Sulfur
- C. Glucose
- D. Pyruvate

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

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- A. True
- B. False

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

- A. The host cell undergoes rapid binary fission.
- B. Infectious virions cannot be detected because they have uncoated and are replicating internally.
- C. The virus is dormant in a lysogenic state within the host genome.
- D. The number of liberated phages reaches a plateau due to nutrient exhaustion.

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

- A. Amino acid chains
- B. Nucleic acids
- C. Proteinaceous capsids
- D. Glycoprotein spikes

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

- A. True
- B. False

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

- A. It lacks enzymes like superoxide dismutase and catalase to neutralize reactive oxygen species (ROS).
- B. Oxygen competitively inhibits the enzymes involved in the Glycolysis pathway.
- C. High oxygen levels cause the cell wall's peptidoglycan layer to dissolve via oxidation.
- D. The organism's ATP synthase specifically requires a CO<sub>2</sub> gradient rather than a proton gradient.