Name: _____ **Date:** _____

Answer Key: Sophisticated Systems: Sustainability Solutions for 10th Grade

Deconstruct the decoupled economic growth model and assess the lifecycle impacts of rare earth mineral extraction in this advanced systems-thinking challenge.

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1. The 'Cradle-to-Cradle' design framework, pioneered by William McDonough, suggests that industrial systems should model themselves on nature's nutrient cycles. Which concept is central to this framework?

Answer: B) Elimination of the concept of waste

Cradle-to-Cradle design differentiates between biological and technical 'nutrients,' aiming for a circular economy where waste becomes an input for a new process.

2. The 'Jevons Paradox' posits that increases in resource efficiency through technological progress often lead to an increase in total resource consumption rather than a decrease.

Answer: A) True

This paradox suggests that as efficiency lowers the cost of use, the increased demand for that resource often offsets the savings gained from the efficiency.

3. A key challenge in the transition to electric vehicles is the ecological and social impact of mining _____, a critical component in high-capacity lithium-ion batteries.

Answer: A) Cobalt

Cobalt mining, particularly in the Democratic Republic of Congo, raises significant ethical and environmental questions regarding the 'green' energy supply chain.

4. When examining the 'Triple Bottom Line,' which scenario represents a failure specifically in the social equity pillar while maintaining economic and environmental standards?

Answer: A) A wind farm built on sacred indigenous land without local consent

While wind energy is environmentally sustainable and may be profitable, ignoring indigenous rights violates the social equity (People) pillar of sustainability.

5. In the context of urban planning, _____ refers to the strategy of increasing housing density near transit hubs to reduce per-capita carbon footprints and land consumption.

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Answer: C) Transit-Oriented Development

Transit-Oriented Development (TOD) maximizes the amount of residential, business, and leisure space within walking distance of public transport.

6. Internalizing 'externalities' means that a company must include the environmental and social costs of production in the final market price of their product.

Answer: A) True

Externalities are costs (like pollution) paid by society rather than the producer; internalizing them is a key economic tool for driving sustainability.

7. The concept of 'Planetary Boundaries' identifies nine Earth system processes that have critical thresholds. Which of the following has been identified by researchers as already being exceeded?

Answer: B) Biogeochemical flows (Nitrogen/Phosphorus)

Excessive use of synthetic fertilizers has pushed nitrogen and phosphorus cycles far beyond the safe operating space for humanity.

8. Blue carbon refers to the carbon sequestered and stored by _____ ecosystems, which are significantly more efficient at storage than terrestrial forests.

Answer: B) Coastal marine

Mangroves, seagrasses, and salt marshes (coastal marine) are highly effective carbon sinks essential for climate mitigation.

9. The 'Precautionary Principle' suggests that if an action or policy has a suspected risk of causing harm to the public or environment, the burden of proof that it is NOT harmful falls on those taking the action.

Answer: A) True

This principle is a cornerstone of environmental law, prioritizing safety and long-term ecosystem health over immediate industrial advancement.

10. Which agricultural method focuses on restoring soil organic matter and biodiversity to actively reverse climate change by sequestering carbon?

Answer: B) Regenerative agriculture

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Regenerative agriculture goes beyond 'sustainable' (maintaining) to 'restorative' (improving), using techniques like no-till and cover cropping to rebuild soil.