

Name: _____ Date: _____

Answer Key: Sustaining Systems: Secrets of Strategic Senior Science

Examine the intricate nexus of life cycle assessments and circular economy frameworks through high-level case studies designed for AP-level critical analysis.

1. When conducting a Life Cycle Assessment (LCA) for a smartphone, which stage typically accounts for the highest 'embodied energy' and largest environmental footprint due to rare-earth element extraction?

Answer: B) Raw material acquisition and refining

In high-tech electronics, the 'upstream' impacts of mining and processing lithium, cobalt, and rare-earths are significantly more energy-intensive than the assembly or distribution phases.

2. The _____ framework focuses on a metabolic shift in manufacturing where industrial outputs from one process serve as nutrient inputs for another, effectively eliminating the concept of waste.

Answer: C) Cradle-to-Cradle (C2C)

Developed by McDonough and Braungart, Cradle-to-Cradle (C2C) mimics biological cycles to ensure materials are either safely returned to the soil or infinitely recycled in technical loops.

3. Jevons Paradox suggests that increasing the efficiency of a resource's use will always lead to a total decrease in the consumption of that resource.

Answer: B) False

Jevons Paradox observes that technological progress increasing resource efficiency often increases the total rate of consumption of that resource because it becomes cheaper/more available.

4. Which of the following best exemplifies the 'Triple Bottom Line' (TBL) evaluation of a corporate wind farm project in a developing coastal region?

Answer: C) Analyzing carbon offsets, local job creation, and long-term profitability

The Triple Bottom Line measures success through three lenses: Planet (environmental), People (social equity), and Profit (economic viability).

5. In the context of the UN Sustainable Development Goals (SDGs), the 'Precautionary Principle' dictates that if an action has a risk of causing severe harm to the public or environment, the burden of proof falls on _____.

Name: _____ Date: _____

Answer: C) Those proposing the action to prove it is safe

The Precautionary Principle shifts the burden of proof to proponents of a new technology or policy, ensuring safety is prioritized even when scientific certainty is lacking.

6. The concept of 'Planetary Boundaries,' developed by the Stockholm Resilience Centre, identifies which of the following as a threshold already exceeded by human activity?

Answer: C) Biogeochemical flows (Nitrogen and Phosphorus)

Research indicates we have significantly crossed the safe operating boundary for Nitrogen and Phosphorus cycles, largely due to industrial agriculture and fertilizer runoff.

7. Intergenerational equity is the principle that current generations have a moral obligation to ensure future generations have access to the same natural capital we enjoy today.

Answer: A) True

This is a foundational tenet of sustainability, arguing that the 'rights' to a healthy environment extend across time to those not yet born.

8. A city implements a 'Congestion Pricing' zone to reduce traffic and emissions. Economically, this is an attempt to internalize a(n) _____.

Answer: B) Negative externality

Pollution and traffic are negative externalities—costs borne by society rather than the producer/consumer. Pricing internalizes these costs by making drivers pay for the impact.

9. In a truly 'Circular Economy,' how is the 'end-of-life' for a biological nutrient (like a wood-based textile) handled?

Answer: C) It is safely composted to restore soil fertility

Biological nutrients are designed to return to the biosphere to rebuild natural capital, whereas technical nutrients are designed for industrial reuse.

10. The 'Rebound Effect' clarifies that improved energy efficiency usually results in an equal percentage reduction in total energy consumption.

Answer: B) False

Name: _____ **Date:** _____

The Rebound Effect explains why efficiency gains often do not lead to proportional energy savings, as users may use the efficient device more frequently or spend saved money on other energy-intensive activities.