Name: _____ **Date:** _____

Answer Key: Invisible Engines, Massive Power: The 5th Grade Cell Design Challenge

Construct biological systems using 10 high-level challenges that move beyond naming parts to synthesizing how organelles collaborate to keep organisms alive.

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1. An architect is designing a 'Smart City' that functions exactly like a plant cell. If the city needs a specialized solar power plant that also produces sugar for the citizens, which organelle-inspired building must be included?

Answer: B) The Chloroplast Conservatory

Chloroplasts are unique to plant cells and perform photosynthesis, converting light energy into chemical energy (glucose), acting as a solar power plant.

2. If a cell's Golgi Apparatus suddenly stopped functioning, the most immediate problem for the organism would be ___.

Answer: C) An inability to package and ship proteins to their destinations

The Golgi Apparatus functions like a post office; without it, proteins cannot be modified, sorted, or packaged for transport.

3. In a multicellular organism, a muscle cell would likely contain significantly more mitochondria than a skin cell because of its high demand for movement and energy.

Answer: A) True

Structure follows function; cells that perform high-energy tasks like contraction require more mitochondria to produce ATP.

4. Imagine a cell is a high-security library. If the DNA represents the rare books that never leave the 'Nucleus Room,' what represents the 'photocopies' sent out to the Ribosome workstations to build proteins?

Answer: B) RNA

RNA acts as the messenger that carries genetic instructions from the nucleus to the ribosomes for protein synthesis.

5. To maintain 'Homeostasis,' the Cell Membrane must be ___, meaning it only allows specific substances like oxygen to pass through while blocking harmful toxins.

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Answer: C) Selectively permeable

Selective permeability is the critical function of the membrane that regulates the cell's internal environment.

6. The primary difference between a cell's 'Excretion' and 'Secretion' is that excretion involves removing waste, while secretion involves releasing useful substances like hormones.

Answer: A) True

Excretion handles metabolic waste disposal (via lysosomes/membrane), whereas secretion is the purposeful release of products made by the cell.

7. Which biological scenario best demonstrates the concept of 'Conductivity' at a cellular level?

Answer: C) A nerve cell passing an electrical signal to a neighbor

Conductivity refers to the ability of cells, particularly neurons, to transmit electrical impulses as a form of communication.

8. In a drought, a plant wilts because its ___ loses water, causing the internal pressure against the cell wall to drop.

Answer: B) Large Central Vacuole

The central vacuole stores water; its turgor pressure provides the structural support that keeps plants upright.

9. A scientist observes a cell under a microscope and notices a thick outer boundary and green oval-shaped structures. Which organism did this cell most likely come from?

Answer: C) A freshwater oak leaf

The presence of a cell wall (thick boundary) and chloroplasts (green structures) indicates it is a photosynthetic plant cell.

10. If the Lysosomes in a cell were to rupture and release their contents into the cytoplasm, the cell would likely begin to digest itself.

Answer: A) True

Lysosomes contain digestive enzymes intended to break down waste; if they leak, those enzymes will attack the cell's own healthy organelles.