Name _____

Powerhouses of the Cell: Exploring the Marvels of Mitochondria

Open-Ended Response Answer Key

1. Mitochondria are double-membrane-bound organelles with an outer membrane and an inner membrane, which is highly folded into structures called cristae. This folding increases the surface area of the inner mitochondrial membrane, providing space for numerous enzyme complexes involved in cellular respiration. The inner mitochondrial membrane is the site where ATP is generated through the process of cellular respiration, highlighting the significance of mitochondrial structure in energy production.
2. Dysfunctions in mitochondrial metabolism can lead to diseases such as mitochondrial disorders, neurodegenerative diseases, and metabolic disorders like diabetes. These dysfunctions may result from mutations in mitochondrial DNA or nuclear genes encoding mitochondrial proteins, leading to impaired ATP production and cellular dysfunction.
3. Mitochondria possess their own DNA and replicate independently of the cell cycle, suggesting an evolutionary origin separate from the cell's nucleus. The endosymbiotic theory proposes that mitochondria originated from ancient symbiotic bacteria that were engulfed by ancestral eukaryotic cells, leading to a mutually beneficial relationship. This theory provides insights into the evolutionary history of eukaryotic cells and the interconnectedness of life.
4. Potential therapeutic strategies for diseases associated with mitochondrial dysfunction include gene therapy to correct genetic mutations, supplementation with cofactors and antioxidants to support mitochondrial function, and pharmacological interventions targeting mitochondrial pathways implicated in disease pathology. Additionally, emerging technologies such as mitochondrial replacement therapy offer promising approaches for preventing the transmission of mitochondrial disorders from mother to offspring.