What Are Mitochondria?

Worksheet

Mitochondria are double-membrane organelles that produce ATP through aerobic cellular respiration, making them the primary energy suppliers of eukaryotic cells.

Questions

1. Which process directly produces the most ATP in mitochondria?

A) Glycolysis
B) Oxidative phosphorylation
C) DNA replication
D) Protein synthesis

2. What structure increases the inner membrane's surface area?

A) Ribosomes
B) Cristae
C) Nucleolus
D) Golgi stacks

3. Where does the Krebs cycle take place?

A) Cytoplasm
B) Mitochondrial matrix
C) Nucleus
D) Outer membrane

4. Mitochondria are believed to have originated from

A) Viruses
B) Free-living bacteria via endosymbiosis
C) Plant cells
D) Random cell division

5. A cell needs to fully oxidize one glucose molecule. How many ATP are produced overall via aerobic respiration?

6. A muscle cell has 2,000 mitochondria and needs 410^9 ATP molecules per second during sprinting. Estimate the ATP output per mitochondrion.

7. A drug blocks Complex I of the electron transport chain. Predict the effect on ATP production.

8. Define: What is the 'powerhouse of the cell'?

9. Define: How many membranes does a mitochondrion have?

10. Define: What are cristae?

Answer Key

1. B) Oxidative phosphorylation - Oxidative phosphorylation (electron transport + chemiosmosis) generates the bulk of ATP.

2. B) Cristae - Cristae are folds of the inner membrane that pack in more electron transport chain proteins.

3. B) Mitochondrial matrix - The Krebs cycle's enzymes are dissolved in the mitochondrial matrix.

4. B) Free-living bacteria via endosymbiosis - The endosymbiotic theory holds that mitochondria descend from engulfed aerobic bacteria.

5. Glycolysis (cytoplasm) yields 2 ATP + 2 pyruvate Pyruvate oxidation converts 2 pyruvate 2 acetyl-CoA Krebs cycle (2 turns) yields 2 ATP plus NADH and FADH2 Electron transport chain + chemiosmosis use those carriers to generate roughly 34 ATP Total 36-38 ATP per glucose

6. Divide total ATP demand by mitochondria count 410^9 2,000 = 210^6 ATP per mitochondrion per second This is why muscle cells pack in so many mitochondria

7. Complex I normally passes electrons from NADH into the chain Blocking it stops electron flow, so no proton gradient is built there ATP synthase output drops sharply The cell falls back on glycolysis, producing far less ATP

8. The mitochondrion - it produces most of a cell's ATP via aerobic respiration.

9. Two: a smooth outer membrane and a folded inner membrane (cristae).

10. Folds of the inner mitochondrial membrane that increase surface area for the electron transport chain and ATP synthase.