What Are Mitochondria?

Worksheet

Mitochondria are organelles that convert nutrients into ATP through cellular respiration, supplying the energy a cell needs to function.

Questions

1. What is the primary function of mitochondria?

A) Protein synthesis
B) ATP production
C) Photosynthesis
D) Waste digestion

2. What theory explains why mitochondria have their own DNA?

A) Mutation theory
B) Endosymbiotic theory
C) Cell theory
D) Evolution theory

3. Where does the electron transport chain occur?

A) Outer mitochondrial membrane
B) Cytoplasm
C) Inner mitochondrial membrane
D) Nucleus

4. Which tissue would you expect to have the MOST mitochondria per cell?

A) Skin
B) Heart muscle
C) Hair
D) Nail

5. Why do heart muscle cells contain far more mitochondria than skin cells?

6. Trace one glucose molecule's energy journey from the cytoplasm to ATP inside a mitochondrion.

7. A drug blocks the electron transport chain in mitochondria. What happens to ATP production?

8. Define: What is the main function of mitochondria?

9. Define: Why are mitochondria called the 'powerhouse of the cell'?

10. Define: What unique feature do mitochondria have that most organelles don't?

Answer Key

1. B) ATP production - Mitochondria generate ATP through cellular respiration.

2. B) Endosymbiotic theory - The endosymbiotic theory holds that mitochondria evolved from free-living bacteria engulfed by ancestral cells.

3. C) Inner mitochondrial membrane - The electron transport chain is embedded in the inner mitochondrial membrane.

4. B) Heart muscle - Heart muscle works continuously and has very high energy demand, so it's packed with mitochondria.

5. Heart cells work continuously and need a constant, high supply of ATP. More mitochondria = more sites for oxidative phosphorylation = more ATP produced per second. Heart muscle can contain over 5,000 mitochondria per cell, versus a few hundred in skin cells.

6. Glycolysis in the cytoplasm splits glucose into 2 pyruvate molecules (net 2 ATP). Pyruvate is transported into the mitochondrial matrix and converted to acetyl-CoA. Acetyl-CoA enters the Krebs cycle, releasing CO2 and generating NADH/FADH2. NADH/FADH2 feed electrons into the electron transport chain, driving ATP synthase to produce roughly 30 more ATP.

7. Electrons can no longer pass through the chain, so the proton gradient across the inner membrane collapses. ATP synthase has nothing to power it, so ATP production drops sharply. The cell must rely on glycolysis alone, which yields far less ATP and can lead to cell death in high-energy tissues like the heart or brain.

8. To produce ATP (energy) for the cell through cellular respiration.

9. Because they generate most of the cell's usable energy in the form of ATP.

10. Their own circular DNA and double membrane, evidence they evolved from free-living bacteria (endosymbiotic theory).