Electron Transport

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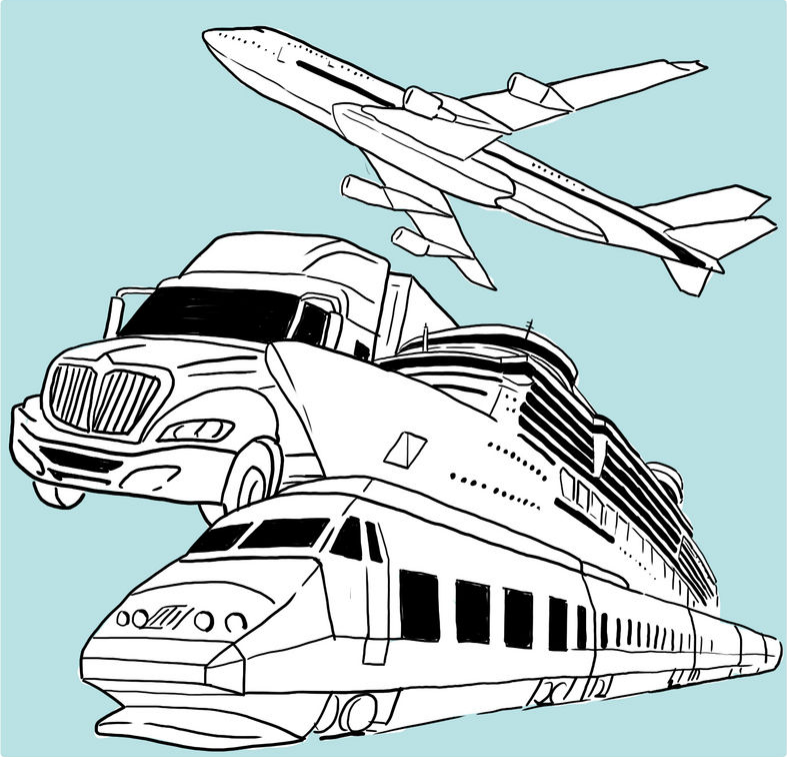
CHAPTER 1 Electron Transport

- Summarize the mitochondrial electron transport chain.
- Identify the products of the Krebs cycle.
- Explain the necessity of oxygen for the mitochondrial electron transport chain.
- Describe a chemiosmotic gradient.
- Explain the synthesis of ATP.



Train, truck, boat or plane?

Ways to transport. To make ATP, energy must be ”transported” - first from glucose to NADH, and then somehow passed to ATP. How is this done? With an electron transport chain.

Cellular Respiration Stage III: Electron Transport

Electron transport is the final stage of aerobic respiration. In this stage, energy from NADH and $FADH_2$, which result from the Krebs cycle, is transferred to ATP. Can you predict how this happens? (*Hint:* How does electron transport occur in photosynthesis?)

Transporting Electrons

High-energy electrons are released from NADH and $FADH_2$, and they move along **electron transport chains**, like those used in photosynthesis. The electron transport chains are on the inner membrane of the mitochondrion. As the high-energy electrons are transported along the chains, some of their energy is captured. This energy is used to pump hydrogen ions (from NADH and $FADH_2$) across the inner membrane, from the matrix into the intermembrane space. Electron transport in a mitochondrion is shown in **Figure** 1.1.

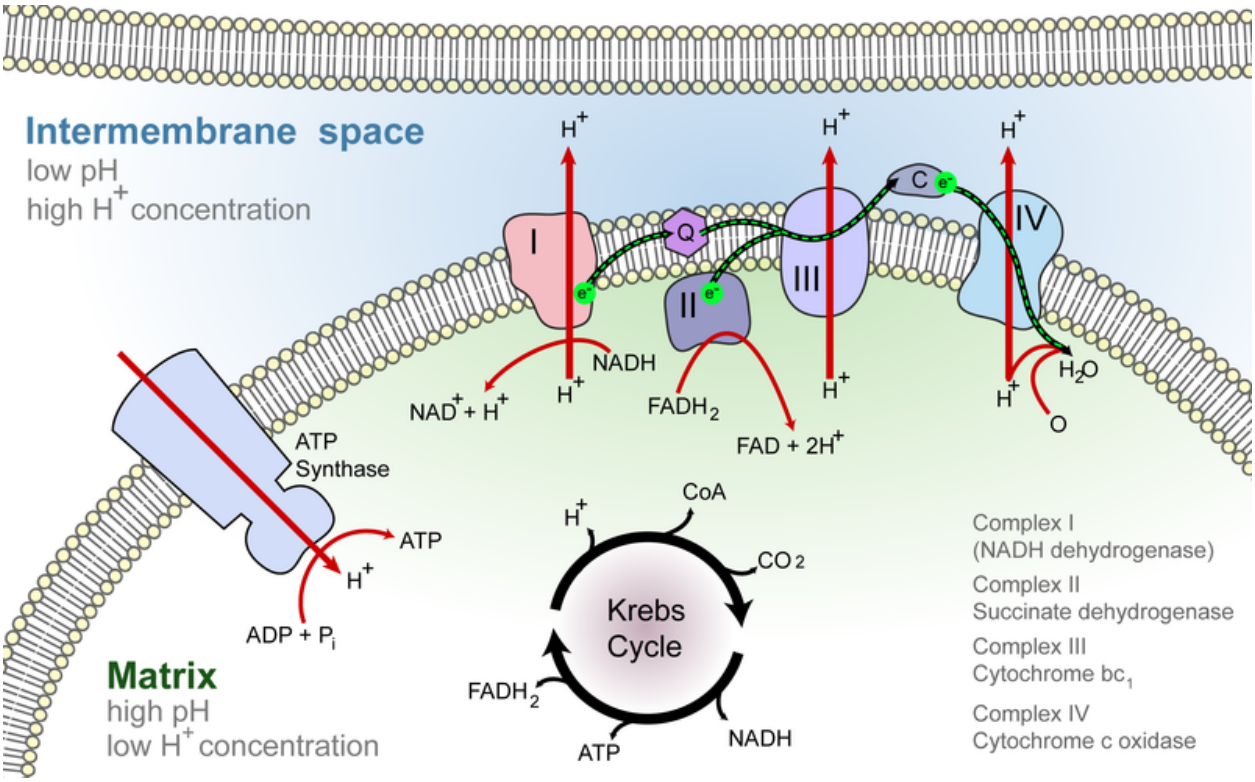


FIGURE 1.1

Electron-transport chains on the inner membrane of the mitochondrion carry out the last stage of cellular respiration.

Making ATP

The pumping of hydrogen ions across the inner membrane creates a greater concentration of the ions in the intermembrane space than in the matrix. This **chemiosmotic gradient** causes the ions to flow back across the membrane into the matrix, where their concentration is lower. **ATP synthase** acts as a channel protein, helping the hydrogen ions cross the membrane. It also acts as an enzyme, forming ATP from ADP and inorganic phosphate. After passing through the electron-transport chain, the "spent" electrons combine with oxygen to form water. This is why oxygen is needed; in the absence of oxygen, this process cannot occur.

How much ATP is produced? The two NADH produced in the cytoplasm produces 2 to 3 ATP each (4 to 6 total) by the electron transport system, the 8 NADH produced in the mitochondria produces three ATP each (24 total), and the 2 $FADH_2$ adds its electrons to the electron transport system at a lower level than NADH, so they produce two ATP each (4 total). This results in the formation of 34 ATP during the electron transport stage.

Summary

- Electron transport is the final stage of aerobic respiration. In this stage, energy from NADH and $FADH_2$ is transferred to ATP.
- During electron transport, energy is used to pump hydrogen ions across the mitochondrial inner membrane, from the matrix into the intermembrane space.
- A chemiosmotic gradient causes hydrogen ions to flow back across the mitochondrial membrane into the

matrix, through ATP synthase, producing ATP.

References

1. Mariana Ruiz Villarreal (LadyofHats) for the CK-12 Foundation. Electron transport chains are the last step of cellular respiration. CC BY-NC 3.0