CHEM 527
Electron Transport & Oxidative Phosphorylation

Coenzymes

Coenzyme-A

FAD and FADH₂

FMN – remove AMP

NAD⁺ and NADH

Figure 19-19
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Cytochromes

Iron protoporphyrin IX
(in b-type cytochromes)

Heme C
(in c-type cytochromes)

Heme A
(in a-type cytochromes)

Fe-Sulfur Clusters

Protein

Figure 19-3
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Figure 19-5
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Citric acid cycle
and fatty acid oxidation
Complex II

Succinate dehydrogenase from citric acid cycle
**Complex III**

(a) Intermembrane space (r side)
- Rieske iron-sulfur protein
- 2Fe-2S
- Heme c₁
- Cysteine c₁
- Heme b₅
- Heme b₆
- Cavern
- Cytochrome b
- Matrix (n side)

(b) Intermembrane space (r side)
- Rieske iron-sulfur proteins
- Heme c₁
- 2Fe-2S
- Heme b₅
- Heme b₆
- Cavern
- Cytochrome b
- Matrix (n side)

Figure 19.11
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**Complex III**

Intermembrane space (r side)
- Cyt c
- Heme c₁
- Cyt c₁
- 2Fe-2S

Matrix (n side)
- Cytochrome b
- Q
- QH₂
- Heme b₅
- Heme b₆

Net equation: QH₂ + 2 cyt c₁ (oxidized) + 2H⁺ → Q + 2 cyt c₁ (reduced) + 4H⁺

Figure 19.12
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![Figure 19.17](http://www.johnkyrk.com/mitochondrion.html)
To transition from glycolysis to the citric acid cycle:

\[ \Delta G^{\circ} = -33.4 \text{ kJ/mol} \]

To Transport Fats in Mitochondria:
acyl-CoA synthetase, which requires 2 ATP equiv. to make acyl-CoA

---

**ATP gained from 1 Glucose**

<table>
<thead>
<tr>
<th>ATP equivalents</th>
<th>Glucose</th>
<th>ATP</th>
<th>ATP equivalents</th>
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<tbody>
<tr>
<td>2 ATP</td>
<td></td>
<td>2 NADH</td>
<td>5</td>
</tr>
<tr>
<td>2 Pyruvate</td>
<td></td>
<td>2 NADH</td>
<td>5</td>
</tr>
<tr>
<td>2 Acetyl CoA</td>
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<td></td>
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</tbody>
</table>

Substrate-level phosphorylation

Oxidative phosphorylation

<table>
<thead>
<tr>
<th>2 GTP or ATP</th>
<th>Citric acid cycle</th>
<th>6 NADH</th>
<th>15</th>
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<tbody>
<tr>
<td>2 FADH₂</td>
<td></td>
<td>2</td>
<td></td>
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</tbody>
</table>

Total: 32 ATP molecules 28