Summary of Electron Transport

Fill out the following chart to summarize the differences between electron transport and chemiosmosis in aerobic respiration and photosynthesis:

<table>
<thead>
<tr>
<th>Purpose of electron transport:</th>
<th>Electron Transport in Cellular Respiration</th>
<th>Electron Transport in Photosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide energy for the active transport of H(^+) across the inner mitochondrial membrane.</td>
<td>Provide energy for the active transport of H(^+) across the thylakoid membrane.</td>
<td></td>
</tr>
<tr>
<td>Organelle(s) involved:</td>
<td>Mitochondria</td>
<td>Chloroplasts</td>
</tr>
<tr>
<td>Specific location of electron transport:</td>
<td>Inner mitochondrial membrane</td>
<td>Thylakoid membrane</td>
</tr>
<tr>
<td>Main supplier of electrons:</td>
<td>NADH (made from glucose molecules)</td>
<td>Pigments (replaced by H(_2)O molecules)</td>
</tr>
<tr>
<td>Role of oxygen:</td>
<td>“Pull” electrons through the ETC</td>
<td>Bi-product</td>
</tr>
<tr>
<td>Role of water:</td>
<td>Bi-product</td>
<td>Replaced electrons in pigment molecules</td>
</tr>
</tbody>
</table>

Electron Transport & Chemiosmosis

The Electron Transport Chain in Photosynthesis:

1. Where in the chloroplast does electron transport occur?  
   Electron transport occurs within the thylakoid membrane.

2. What molecule(s) supply the electrons to the electron transport chain in photosynthesis?  
   Water molecules supply electrons for electron transport in photosynthesis.

3. Where did these electrons originally come from? (Which molecule?)  
   The molecules were originally from chlorophyll molecules and are replenished by water molecules.

4. Where do the electrons end up after electron transport in photosynthesis?  
   The electrons from electron transport in photosynthesis end up being carried by NADPH molecules.

5. What is the role of light energy in the electron transport chain?  
   Light energy excites electrons in the pigments of the photosystems. These excited electrons then pass through the electron transport chain.

6. What is the purpose of water in the electron transport chain of photosynthesis?  
   The purpose of water in the electron transport chain of photosynthesis is to replenish electrons that have been excited in the chlorophyll molecules.
7. The movement of electrons through the electron transport chain generates energy. What is this energy used for in regards to the protons (H⁺)?
   The energy generated by the movement of electrons is used to pump electrons across the thylakoid membrane to an area of higher concentration.

8. Where do these protons (H⁺) come from?
   The protons come from water molecules.

9. What will these protons that have accumulated inside of the thylakoid membrane be used for?
   These accumulated protons will be used to power ATP synthesis.

10. After ATP synthesis, where do the protons (H⁺) end up?
    After ATP synthesis, the protons are carried by NADPH to the Calvin cycle where they become part of a glucose molecule (C₆H₁₂O₆).

The Electron Transport Chain in Aerobic Respiration:
1. Where in the mitochondria does electron transport occur?
   Electron transport in cellular respiration occurs within the inner mitochondrial membrane.

2. What molecule(s) carry the electrons to the electron transport chain in cellular respiration?
   NADH and FADH₂ carry electrons to the electron transport chain in cellular respiration.

3. Where did these electrons originally come from? (Which molecule?)
   These electrons were originally part of a glucose molecule.

4. Where do the electrons end up after electron transport in cellular respiration?
   After electron transport in cellular respiration, the electrons are attracted to oxygen molecules (O₂) which combine with protons (H⁺) to make water (H₂O) molecules.

5. What is the purpose of oxygen in the electron transport chain of cellular respiration?
   The purpose of oxygen in the electron transport chain of cellular respiration is to remove electrons from the transport chain, allowing electron transport to continue.

6. The movement of electrons through the electron transport chain generates energy. What is this energy used for in regards to the protons (H⁺)?
   The energy generated by the movement of electrons is used to pump electrons across the inner mitochondrial membrane to an area of higher concentration.

7. Where do these protons (H⁺) come from?
   The originally came from a glucose molecule and were carried to the electron transport chain by NADH and FADH₂.
8. What will these protons that have accumulated between the inner and outer membranes of the mitochondria be used for?
   These accumulated protons will be used to power ATP synthesis.

9. After ATP synthesis, where do the protons (H+) end up?
   After ATP synthesis, the protons combine with oxygen to form water molecules.

**Chemiosmosis:**

*Electron transport provides energy for the synthesis of ATP, but only indirectly. When electron transport chains pump H+ across the membrane, the protons become more concentrated on one side of the membrane than on the other. Such a concentration gradient stores potential energy. ATP is generated by a molecule called ATP synthase. ATP synthase is a combination of proteins that act as both an ion channel and an enzyme. As an ion channel in the membrane of the mitochondria or thylakoids, it allows H+ to diffuse through it. This action spins a component of the ATP synthase. This rotation activates the active sites in the enzyme that attach phosphate groups to ADP molecules to generate ATP.*

1. What molecule(s) is/are directly involved in the synthesis of ATP?
   ATP Synthase is a combination of protein molecules that are directly involved in producing ATP.

2. What type of passive transport occurs through the ATP synthase molecule?
   Facilitated diffusion is the type of passive transport that occurs through the ATP synthase molecule. ATP synthase acts as an ion channel that allows hydrogen ions (protons) to diffuse.

3. What is the difference between ADP and ATP?
   ADP (adenosine diphosphate) has only two phosphate groups. ATP (adenosine triphosphate) has three phosphate groups. The bond between the second and third phosphate group contains the energy that powers cells.

4. What is the ATP that is made during chemiosmosis of aerobic respiration used for?
   ATP produced during cellular respiration is used to power cellular processes such as active transport, protein production, movement, growth and maintaining homeostasis.

5. What is the ATP that is made during chemiosmosis of photosynthesis used for?
   The ATP produced during photosynthesis is used to power the Calvin cycle and produce glucose.