Teaching the Electron Transport Chain

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We have used the technique presented here to successfully teach electron transport to groups of from 12 to 40 students in both lecture and laboratory settings. The goal is to emphasize the concept that energy is released and stored as bonds are broken in one molecule and formed in another. This technique also helps students to connect laboratory experiments (which often focus simply on the beginning and end-products of respiration) with the more complex pathways they are learning in lectures.

The materials required for each student are one small paper cup, one piece of candy, and one sign. We make one sign for each carrier molecule in the electron transport chain, and enough signs with "oxygen" printed on one side and "water" printed on the other to give one sign to every member of the class. It is important that the signs be large enough to be read by all members of the class. We make our signs using the poster option in the computer program Printshop. The posters are enlarged to 11" × 17" on a copy machine. We attach yarn to the signs representing the carrier molecules, so that the students wearing these signs are able to put them around their necks and free their hands.

As students enter the room, hand each student a sign and a cup. The signs assign students to represent the carrier molecules in the electron transport chain (NAD, FMN, C_oQ, cytochromes), or to become oxygen. Have the students who represent the carrier molecules line up in the correct order. The remaining students line up on one side of the room with their signs showing oxygen. (We sometimes have to "tease" the students into doing this). Explain to the students that the candy represents electrons, and at any one time a student may only have one piece of candy in his or her cup. Drop a piece of candy into the cup of the student representing NAD (this is an appropriate time to review REDOX), have the students act out a "bucket brigade" ending with one of the "oxygens" receiving a piece of candy and becoming "water." Repeat until all the "oxygen" has become "water." We bring a few extra pieces of candy to the class and allow the chain to backup, leaving all the electron carriers in the reduced state. This lends itself to a discussion of the relationship between aerobic and anaerobic respiration.