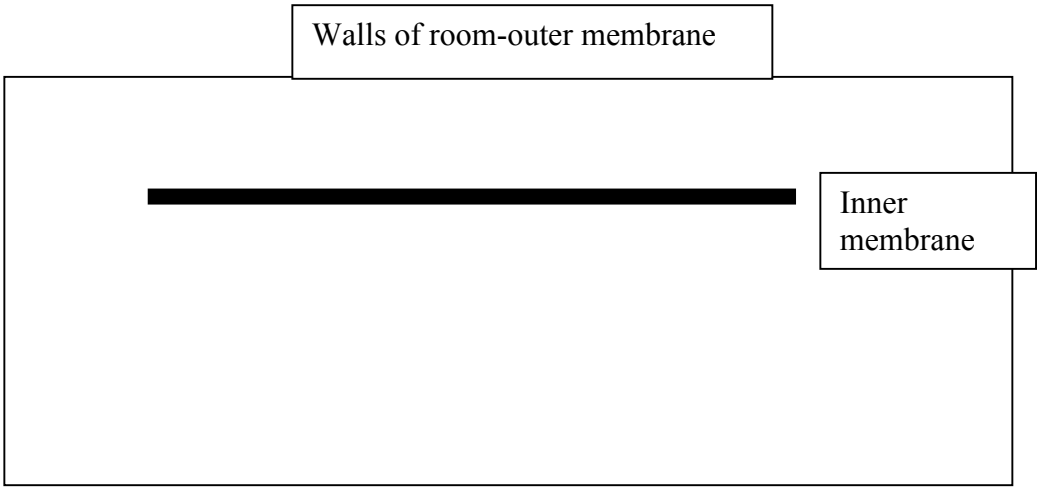
The Electron Transport Chain Drama

This is a full class kinesthetic activity which makes the very abstract ETC familiar. It usually takes about 45 minutes. No preparation is needed except to have a handful of highlighters handy.

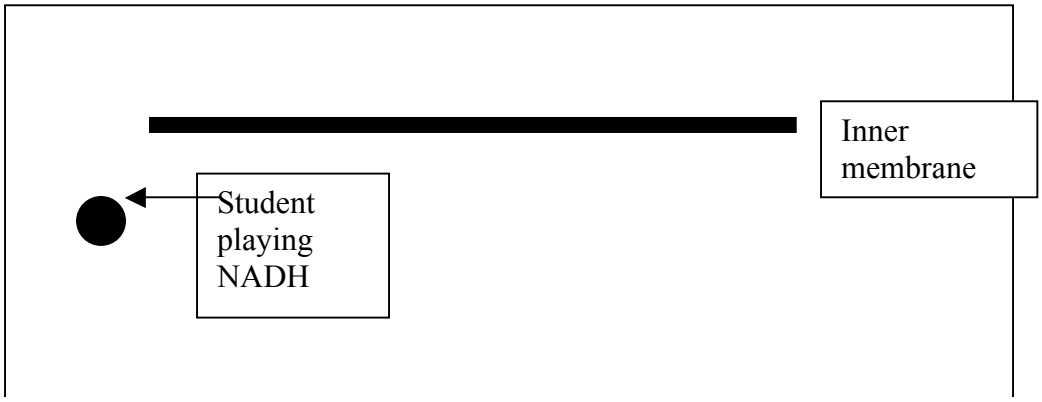
Put all students on one side of the room. Clear the desks, etc. out of the way so you have a large clear open area.

Take the time at each step to be very clear about what you are modeling.

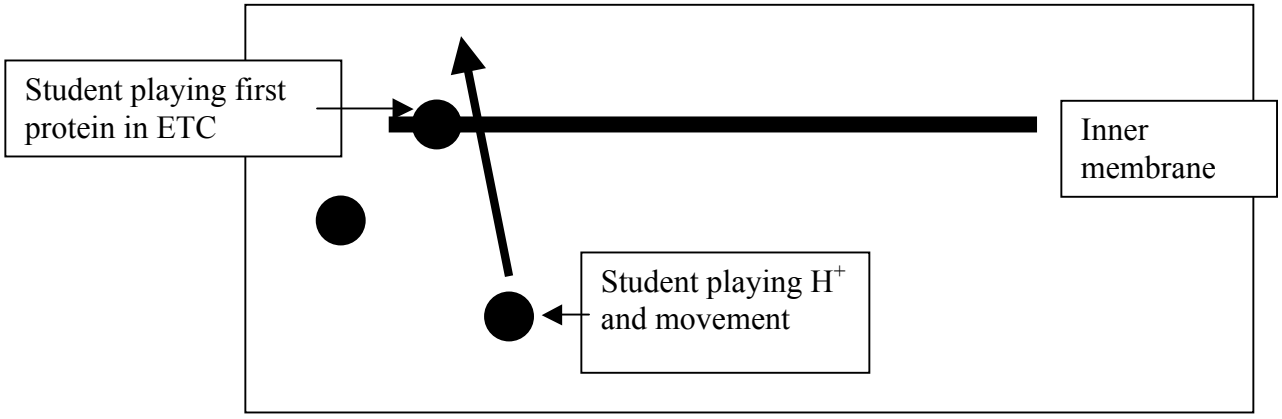
1. Tell the students the room is a mitochondrion and the walls are the outer membrane. Walk a line of tiles and tell student this is the inner membrane. All ETC proteins will be placed here.



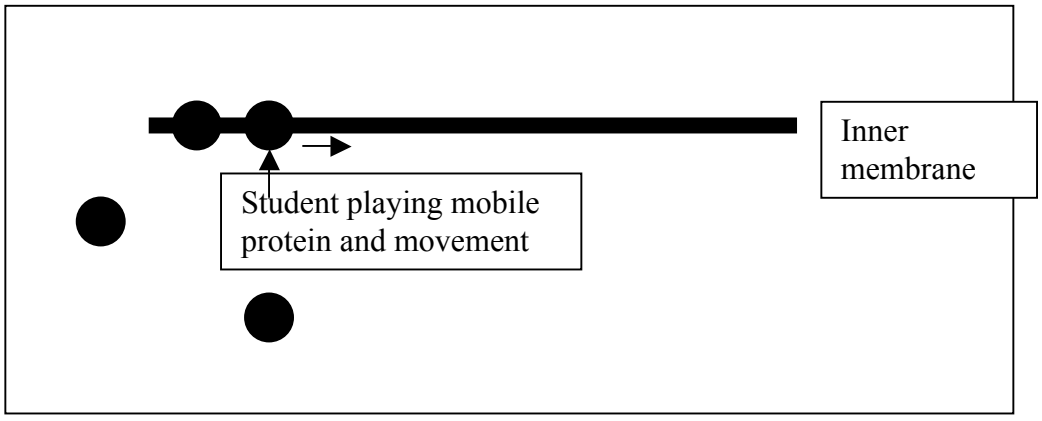
2. Select a student to be the NAD^+/NADH. I use a pair of highlighters to represent a pair of electrons. Make a point here. "When you have electrons you are reduced, when you give them away, you are oxidized." Practice this with students, handing over the highlighters and taking them back). I like to use OIL RIG (oxidation is loss, reduction is gain). Discuss where the NADH came from (many from the Krebs or Citric Acid Cycle). Place this student at the start of the inner membrane where you will build your ETC.



3. The next student will be the first protein in the ETC. How technical you get here on naming depend on the level of your students and your desire. Consult your textbook to include extra detail. Place them on your tile line. Have the NADH hand over the electrons (highlighters). After practicing this, emphasizing oxidation/reduction, tell them when electrons move down the chain, hydrogen ions are moved across the inner membrane. Have the ETC protein grasp the hand of another student (now designated a hydrogen ion) and move them to the other side of the membrane. This should accompany the passage of electrons.

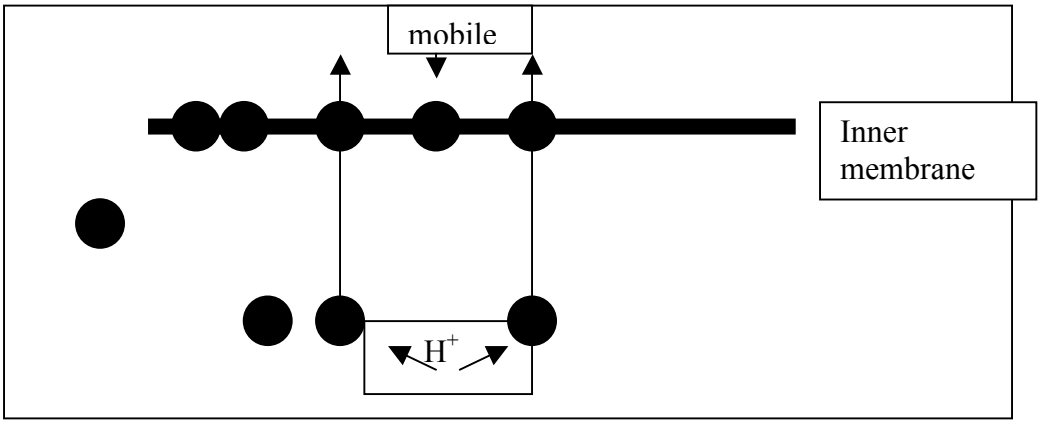


4. Place next student, a mobile carrier. They move electrons but do not translocate H^+. They should move a short distance after receiving electrons (pair of highlighters).



5. Place the rest of the student "ETC proteins" in this manner, each being instructed to transfer electrons (pairs of highlighters) to next protein in chain. Third and

fifth protein in the chain are fixed and move hydrogen ions. Fourth is mobile and does not move hydrogen ions.



6. Run the electron movement for a while. Hydrogens are being moved across the membrane by the 1st, 3rd and 5th student "protein complex." The last student "protein" in the chain will begin to get frantic as she keeps getting handed highlighters (electrons) and there is no where to put them. Watch for this, then stop the action while you add the next step.

7. Assign a student to be oxygen. The role of oxygen as the final electron acceptor should be discussed. After O takes a pair of electrons, he should link with two H^+ students to form water.

8. Students will notice the H^+ building up on one side of the membrane. It's nice if they are getting crowded and fussy. Discuss this potential energy as proton motive force. How can it be harvested?

9. Next student will be ATP synthase. She will be placed in the inner membrane and hold arms out slowly spinning. Instruct the H^+ to flow back into the matrix through this revolving door.

10. Next students will be ADP and inorganic phosphate. As H^+ flow through they clap hands and give a loud "Poof ATP."

11. Run "drama" for a few minutes. Then take questions and have students switch roles.