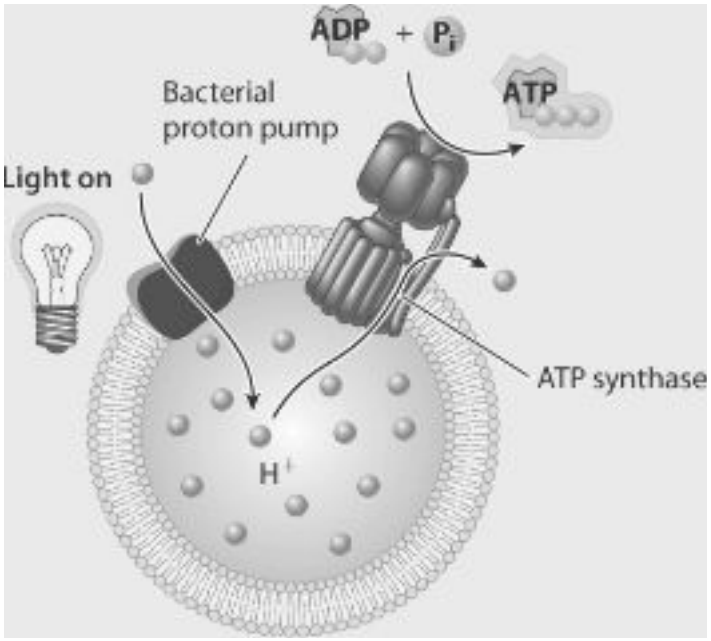
Chemiosmotic Coupling

Name_____

Use the image and information to determine what was learned by the researchers.

In 1961, Peter Mitchell proposed the *chemiosmotic hypothesis* that an electrochemical proton gradient generated the energy that drives ATP synthesis. The proton gradients are generated during the electron transport chain in both photosynthesis and cellular respiration.



Racker and Stoeckenius (1974) demonstrated that they could make an artificial ATP-generating system to support the idea. They combined ATP synthase from the mitochondria of a cow heart muscle with a proton pump from the bacteria *Halobacterium halobium* in a vesicle. In the presence of light, the pump, bacteriarhodopsin, moves protons across a membrane.

1. What does ATP synthase make?

2. What is meant by a *gradient*?

3. How does energy enter the system?

4. Where does the energy end up in this system?

5. Racker and Stoeckenius made modifications of the vesicle. Predict what happened to the production of ATP in the following situations:

   Light was shut off:

   Vesicle did not contain ATP synthase:

   Vesicle did not contain a proton pump:

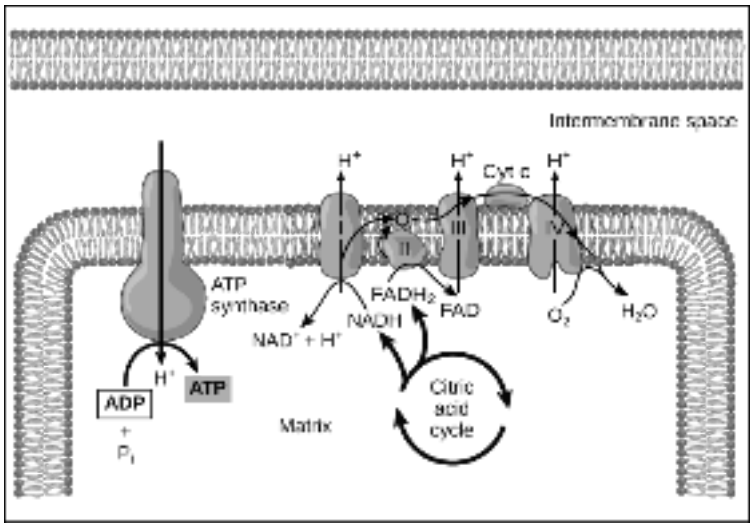
6. They added to the vesicle an uncoupling agent. This channel allows the protons to flow freely through the membrane and out of the vesicle.. What happens to ATP production? Why?

7. Restate what this experiment demonstrated.

To the right is a diagram of a cross section of the mitochondria.

8. As cellular respiration is occurring, what happens to the proton(H+) concentration in the intermembrane space?

9. Where do the protons go from the intermembrane space and what does it do?



10. Predict what would happen if an uncoupling agent was added to the inner membrane of the mitochondria.

11. If not into ATP, predict where the energy from the light would go when the uncoupling agent is in the membrane.