**The Energy of Electron Transfer Is Efficiently Conserved in a Proton Gradient**

* The transfer of two electrons from NADH through the respiratory chain to molecular oxygen can be written as

NADH + H+ + ½ O2 NAD+ + H2O

* This net reaction is highly exergonic. Go = - 220 kJ/mol
* Much of this energy is used to pump protons out of the matrix **(Fig. 19-16)**.





* The energy of electron transfer is efficiently conserved in a proton gradient.
* The energy stored in such a gradient, called the **proton-motive force**.
* In mitochondria, the electrochemical energy in the proton gradient drives the synthesis of ATP from ADP and Pi.

**Reactive Oxygen Species Are Generated during Oxidative Phosphorylation**

* Several steps in the path of oxygen reduction in mitochondria have the potential to produce highly reactive free radicals that can damage cells.



* The superoxide free radical thus generated is highly reactive; its formation also leads to production of the even more reactive hydroxyl free radical,.
* To prevent oxidative damage by superoxide free radical, cells have **superoxide dismutase**, which catalyzes the reaction **(Fig. 19-18).**



* The hydrogen peroxide is rendered harmless by the action of **glutathione peroxidase (Fig. 19-18).**





