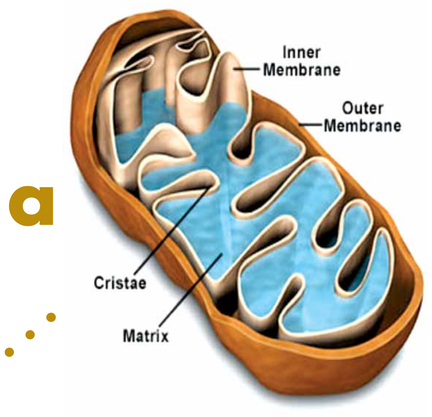
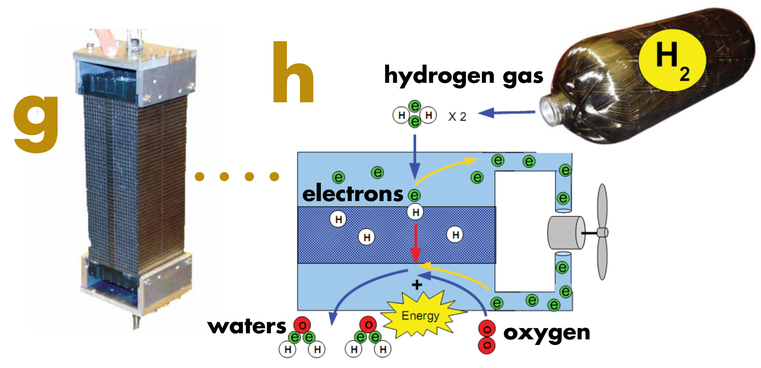
Modeling Nature's Fuel Cell

Using computers to model mitochondria—the natural fuel cells in our bodies—we hope to improve the design of artificial fuel cells.

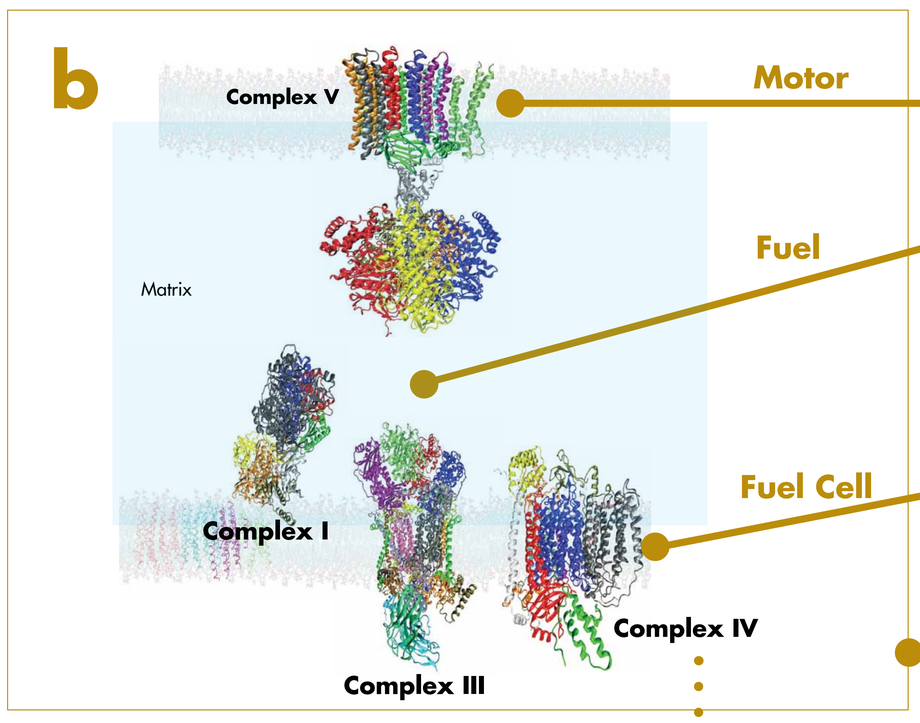
FUEL CELLS offer an alternative transportation technology that releases innocuous emissions. The design of fuel cells have made considerable advances, however, several issues need to be addressed before fuel cells are widely used. Nature has it's own version of the fuel cell which is a robust and efficient design. In the Stuchebrukhov lab at UC Davis, we use computers to model natural fuel cells in the hope that the information gained from these studies can help to improve the design of artificial fuel cells.

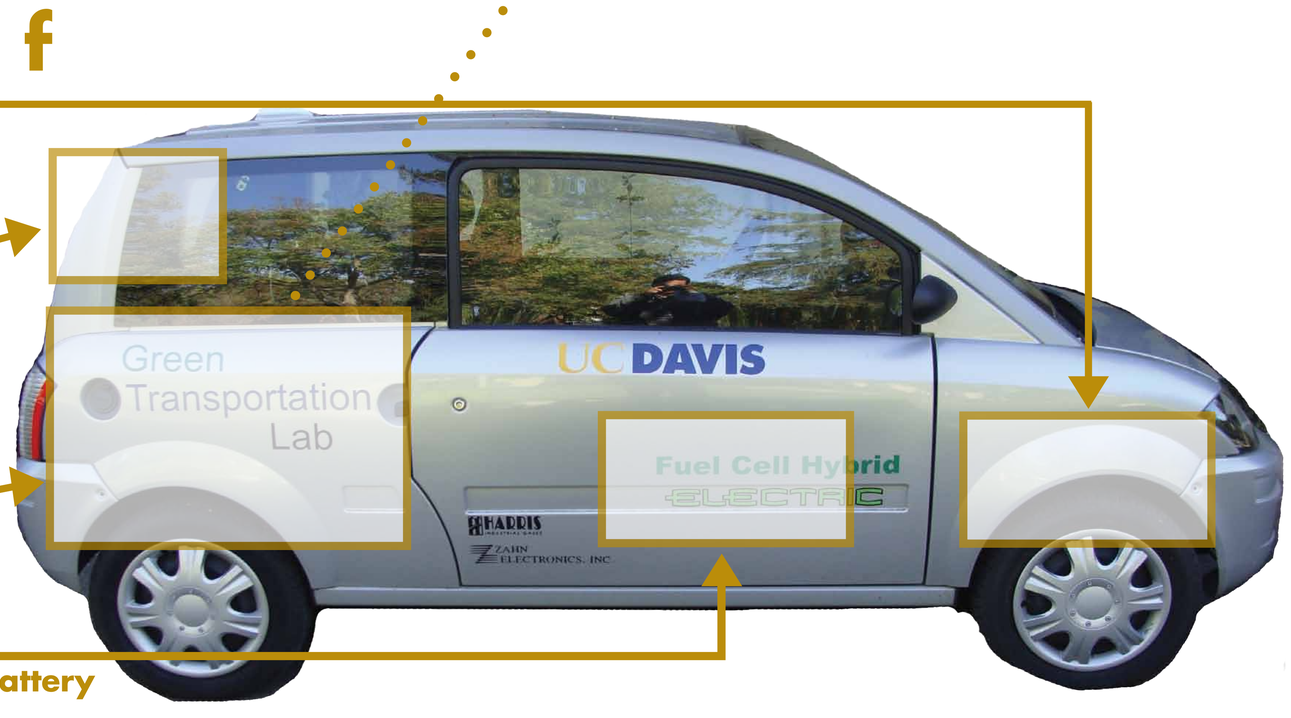


▲ Mitochondria (**a**) are the "power plants" of the cells in our bodies. Small biological machines within mitochondria, known as proteins (**b**), work in concert to generate the energy that is needed to support life. The proteins in mitochondria share functions similar to those found in fuel cell vehicles (**b** and **f**).



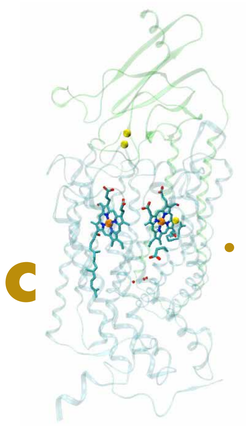
▲ Artificial fuel cells (**g**) combine substances from a fuel, such as hydrogen gas, with air to produce water and energy (**h**) much like natural fuel cells. Unlike natural fuel cells, however, artificial fuel cells use rare metals and the proper control of processes within these fuel cells may be problematic.

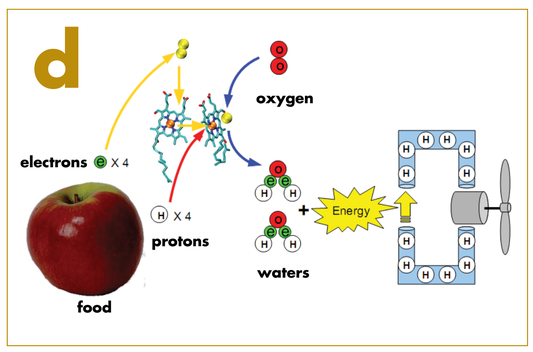




▲ Artificial fuel cells have developed into promising sources of energy and transportation as demonstrated by the fuel cell hybrid vehicle of the UC Davis Green Transportation Lab. Many of the parts that make this vehicle work, including the fuel cell, are similar to ones already found in nature.

A protein in mitochondria, known as Complex IV (**c**), combines the air that we breathe with substances from the food that we eat to produce water and energy (**d**) in a process that is similar to that found in artificial fuel cells. Unlike artificial fuel cells, however, Complex IV controls this process more efficiently while incorporating parts that are abundant and inexpensive. ▶





◀ Computers can now model systems as complex as the proteins found in mitochondria. These models provide insight into how these proteins can work so efficiently, durably, and exquisitely with abundant and inexpensive parts. The goal is to take these insights and translate them into artificial fuel cell designs.

ENERGY

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