Amount of time Demo takes: 3-5 min
Materials:
1. Hydrogen car, fuel cell, and battery pack
2. Syringe
3. Distilled water (1 gallon/event)

Set up instructions:
1. Directions and diagram are on page 8 of the manual (more detailed and with diagrams!). Fill car up with distilled water in the rear tank. Regular water will damage the vehicle.
2. Prepare the syringe by attaching the 6cm tube to the syringe. Fill fuel cell with water by removing the air from each side of the fuel cell with the syringe. When you start to see a steady flow of water with no air bubbles coming out of the fuel cell and into the syringe, you can stop. Pinch off the tube, remove the syringe, and reinsert the cap. Do this on both sides.
3. Plug in the battery pack connectors to fuel cell, matching the red and black wires to corresponding red and black sides. The fuel cell will separate the hydrogen and oxygen into the rear tanks. When it’s done, remove the connectors. The gas will stay in the tanks until you run the car.
4. Holding the car off of the table/floor, plug in the motor wires (plug in red/black wires to corresponding red/black sides). Turn the wheels so the car will travel in a circle. You will need about a 4-ft circle; you could use the extra large hula hoop from the bubbles kit to help keep students out of the car’s path.

SAFETY!
1. Keep away from flames, oil, and grease. Hydrogen and oxygen gasses are combustible. Igniting them would damage the equipment and could hurt participants/yourself.
2. Use only in a well-ventilated area.
3. Do not charge with rechargeable batteries.
4. Do not attach wires directly to each other or reverse the polarity by connecting to the incorrect side of fuel cell.

Lesson’s big idea
- This lesson demonstrates what a fuel cell is; changing chemical energy into electrical energy; electrolysis; and clean alternative ways to generate energy.
- The set up for the fuel cell in this demonstration is not practical on a large scale, but it demonstrates that there are clean alternatives to power vehicles besides gasoline, oil and coal. The downfall to this is that you need a battery source to separate the hydrogen and
oxygen in the water molecules - that is, you still have to use a lot of energy to get it ready to run. Plus, you are storing gasses that are easy to ignite.

**Instructional Procedure**
1. Set out a drawing or model of a water molecule to help participants understand that electrolysis splits the hydrogen and oxygen to store them as gasses. When they recombine into water, they power the car.
2. A fuel cell is an electrochemical cell that converts chemical energy from a fuel into electric energy. Electricity is generated from the reaction between a fuel supply and an oxidizing agent. The reactants flow into the cell, and the reaction products flow out of it, while the electrolyte remains within it. Fuel cells can operate continuously as long as the necessary reactant and oxidant flows are maintained. Fuel cells are different from conventional electrochemical cell batteries in that they consume reactant from an external source, which must be replenished – a thermodynamically open system. By contrast, batteries store electric energy chemically and hence represent a thermodynamically closed system. Many combinations of fuels and oxidants are possible. A hydrogen fuel cell uses hydrogen as its fuel and oxygen (usually from air) as its oxidant. Other fuels include hydrocarbons and alcohols. Other oxidants include chlorine and chlorine dioxide. [http://en.wikipedia.org/wiki/Fuel_cell](http://en.wikipedia.org/wiki/Fuel_cell)

3.

**Assessment**

Sample questions you can ask:
1. What are the two gasses that separate in electrolysis of water?
2. What powers the car?

**Clean Up**

Clean up between demonstrations if needed. When completely finished gather all materials listed for this demonstration and make sure everything is accounted for. If something was used up, broken or damaged, let someone know so it can get replaced or fixed. Remove batteries from battery pack - if the wires touch when the unit is stored, it will drain the batteries. Dump out water from fuel cells. Dry equipment off before storing in kit.
References:

National Standards:
K-4 Content Standard F, Science in personal and social perspectives, Science and technology in local challenges
K-4 Content Standard B, Physical Science, Light, heat electricity and magnetism
5-8 Content Standard F, Science in personal and social perspectives
5-8 Content Standard B, Physical Science, Transfers of energy
9-12 Content Standard F, Science in personal and social perspectives
9-12 Content Standard B, Physical science, Chemical reactions