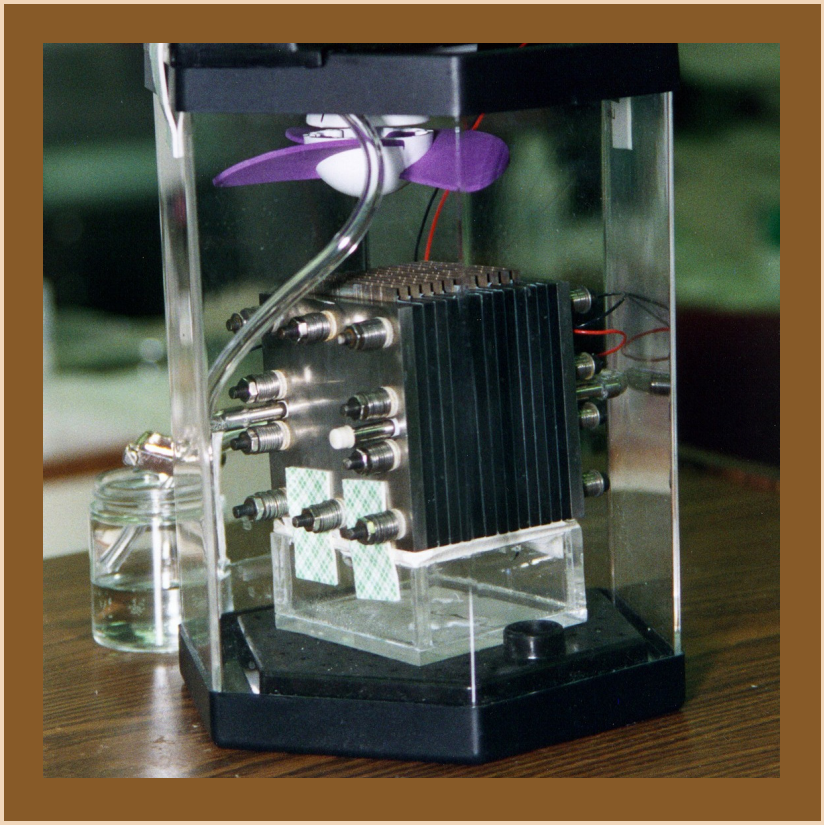
STEM Sims™

Fuel Cells



STEM Sims™

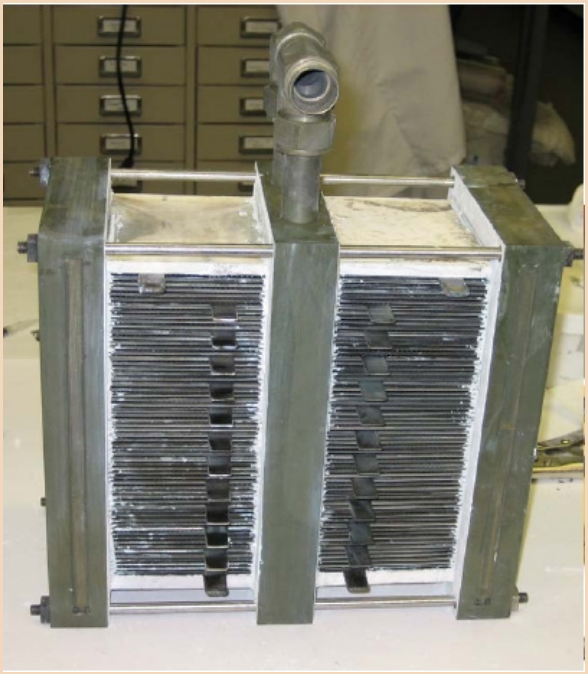
Fuel Cells

Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Start learning right now about the applications of fuel cells in contemporary engineering. Take the following brief quiz to see how much you already know about fuel cells. See the bottom of page 4 to check your answers.

1. Which type of energy conversion occurs in fuel cells?
   a. mechanical to chemical energy
   b. heat to chemical energy
   c. kinetic to potential energy
   d. chemical to electrical energy

2. Which of the following is *not* a byproduct of the reaction between hydrogen and oxygen in a fuel cell?
   a. water vapor
   b. heat
   c. light
   d. electricity



3. How energy efficient are hydrogen fuel cells?
   a. 20%
   b. 60%
   c. 85%
   d. 100%

4. When was the first hydrogen fuel cell built?
   a. In the late 1830s by William Grove
   b. In the late 1930s by Francis Bacon
   c. In the mid 1950s by W. Thomas Grubb
   d. In the late 1950s by Harry Ihrig

5. Because there are no movable parts, fuel cells are nearly silent.
   a. true
   b. false

World “Series” or “Parallel” Universes?

While sports enthusiasts may prefer to discuss series and theoretical scientists prefer to discuss parallel, both present interesting benefits when it comes to circuitry. The best way to learn is by doing, so get “brighter” by trying out this experiment!

Supplies Needed

a 9V battery
tape
safety gloves
adult supervision
aluminum foil
2 flashlight bulbs
safety goggles

Procedure

Part I.

1. Cut out two 1 cm × 20 cm strips of foil.
2. Tape one strip to the positive (+) terminal of the battery (making sure the metals touch) and the second strip to the negative (-) terminal of the battery (making sure the strips do not touch each other).
3. Wrap the positive strip of foil to the bottom of your first light bulb.
4. Cut out a 1 cm × 10 cm strip of foil and wrap one end around the second light bulb.
5. Connect the 10 cm strip’s loose end to the first light bulb and the negative strip of foil to the second light bulb.
6. Record how bright the bulbs appear. This is your series circuit.

Part II.

7. Disassemble the light bulbs from the circuit.
8. Cut two 1 cm × 10 cm strips of foil and fold each of the ends around the positive strip of foil.
9. Wrap the opposite ends of the 4-inch strips around the base of each light bulb.
10. Place the base of each light bulb against the negative strip of foil so that the metal of the bulb is touching.
11. Record how bright the bulbs appear. This is your parallel circuit.

Questions

1. Which bulbs were brighter, those in the series circuit or those in the parallel circuit? Why is that?

2. Which circuit type would be more effective for strings of holiday lights if it is possible one bulb could burn out?

Fuel Cells

She Sells Fuel Cells by the Seashore

While the designs for fuel cells have existed for a long time, they have only been considered as a serious contender in the energy market recently. Fuel cells are incredibly energy efficient and hydrogen fuel cells in particular are environmentally friendly; their largest drawback is the expense of the technology. Fuel cells also require multiple stacks, which makes them rather heavy.

The parts of the fuel cell are the anode, the cathode, and the electrolyte in between. A catalyst at the anode breaks down the fuel into positive ions and negative electrons. The electrolyte in the middle allows only the ions to pass to the cathode. The electrons travel along a wire, which generates current through the load, and back to the cathode, reacting with a chemical there to create water or carbon dioxide. Because of these byproducts created by the system, the maximum energy efficiency of a fuel cell is 83% in theory, though in practice it is lower (though still high compared to combustion engines, which are approximately 25% efficient). In addition to its excellent efficiency, it does not have a “lifespan” like a battery; it will continue to operate assuming that it has a continuous fuel supply.

There are many applications for fuel cells; fuel cell electric vehicles (FCEVs) are already in production. There are buses, forklifts, motorcycles, airplanes, boats, submarines, and cars already developed using fuel cell technology. Fuel cells are even being considered for computers, smartphones, and tablets. NASA also uses fuel cells in the space shuttle. Three fuel cell power plants are used to create all of the energy required for the shuttle from takeoff to landing, and the excess water is sent to be used in the potable water system. What will the future hold for environmentally friendly energy sources? Can you design a working fuel cell and optimize its structure to get the most energy?

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STEMsims.com

Answers: Page 2 Answers: 1) d. 2) c. 3) b. 4) a. 5) a. **Page 3 Answers:** 1) The bulbs in series should be brighter because they have more current flowing through them. 2) Parallel would be better because it does not depend on order for flow.

The Green Engineering Magnet (GEM) project was funded in part under the National Science Foundation grant contract #IIP-1127544. Its contents are solely the responsibilities of the authors and do not necessarily represent the official views of the National Science Foundation.