

Motor



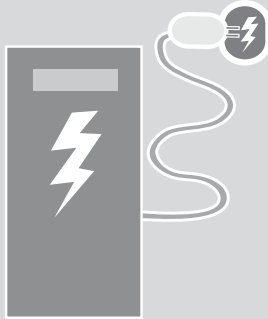
The motor turns electrical energy into kinetic energy, which then moves the electric car. Motors are based on the concept of electromagnetism. They use magnets and wires to generate magnetic fields. Electric cars don't burn fuel so there are no emissions, and they have lower maintenance and energy costs than other cars.

Batteries



An electric car stores energy in batteries. A battery converts chemical potential energy into electrical energy. Battery types include: lead acid, nickel metal hydrides, lithium ion, and zebra or sodium batteries. Any two metals can be used to make a battery, as long as a chemical reaction can occur between them. Batteries are the most expensive part in an electric car. Advances in battery technology are expected to bring the cost down while extending the range of the electric car.

Charger/Charging Station



To get the electricity into the batteries that run the motor of an electric car, you need a charger and a charging station. The charging station connects the car to the electric grid. The charger controls how much electricity is going into the batteries and how fast it is flowing. The charger is part of the car instead of the charging station because every electric car is different. Since charging stations are universal, any electric car can plug in anywhere.

Regenerative Braking



When a car stops, the energy generated is lost to friction and heat. Regenerative braking reclaims about 10 to 15% of that energy and puts it back into the batteries. It converts the kinetic energy of the car into a more storable form. During braking, the motor acts as a generator, transferring energy from the wheels to the batteries, and causing the car to stop.

written by Tina Fanetti and Jennifer Jovanovic

illustrated by Dennis Smith

© 2012, Saint Louis Science Center

Funded by a Grant from the U.S. Department of Energy



Unplugged: How Technology Drives the Electric Car

Motor...

The motors turn electrical energy into kinetic energy which moves the car.

Charger...

The charger connects the car to the charging station to get electricity to the batteries.

Look inside to find out how to make one!

Batteries...

The electric car's energy is stored in the batteries.

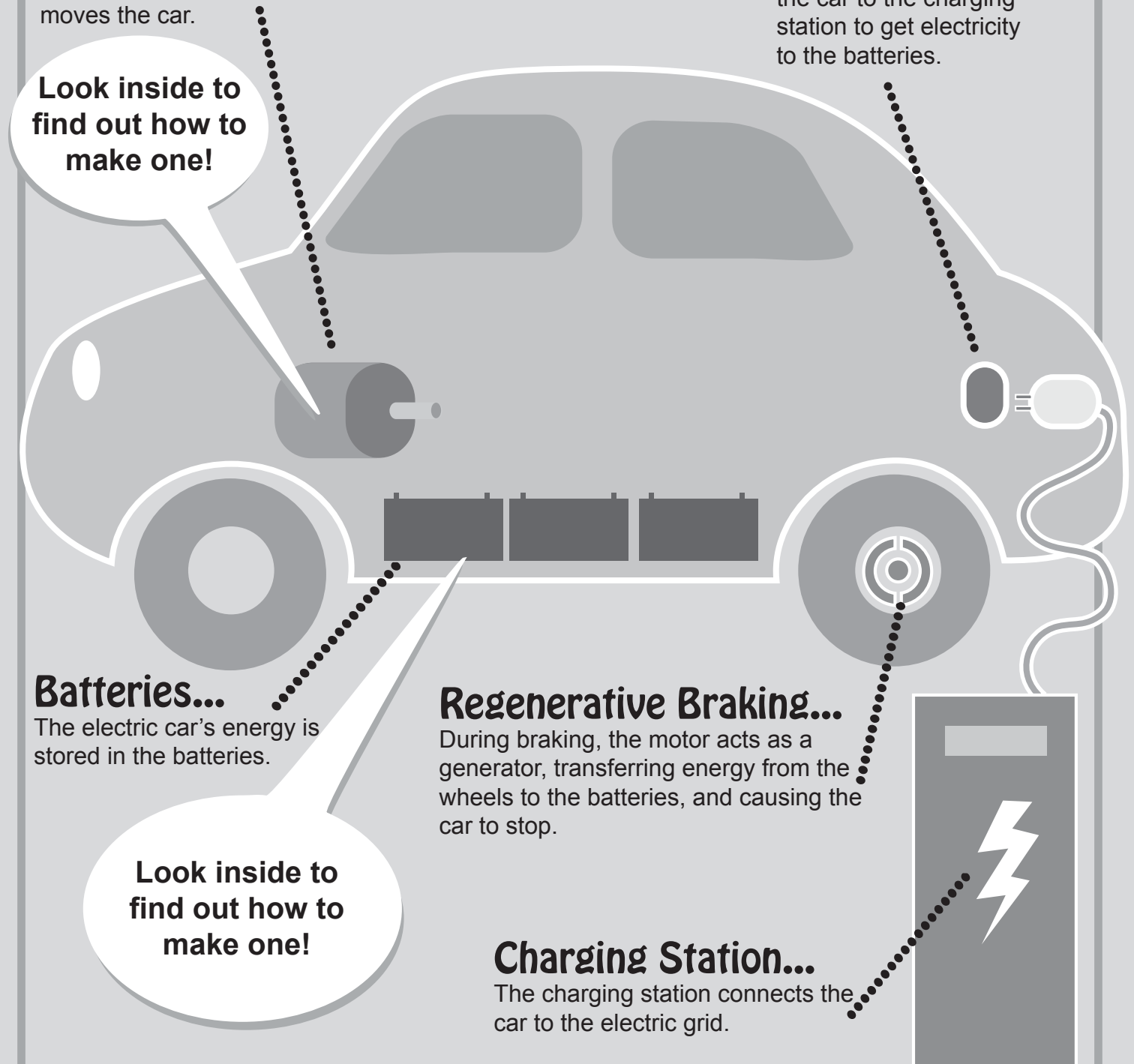
Look inside to find out how to make one!

Regenerative Braking...

During braking, the motor acts as a generator, transferring energy from the wheels to the batteries, and causing the car to stop.

Charging Station...

The charging station connects the car to the electric grid.

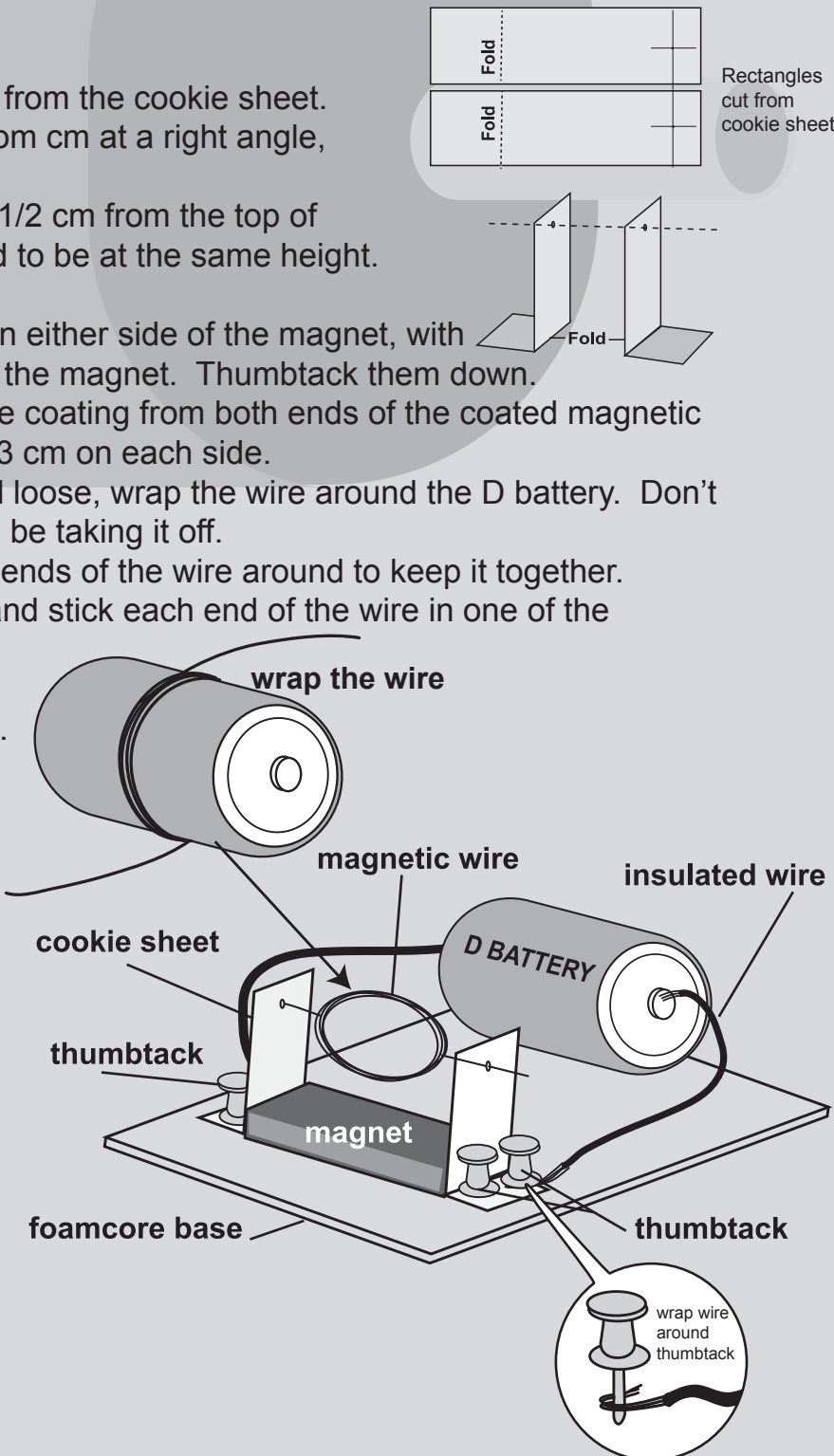


Build A Motor

You will need:

disposable cookie sheet, ruler marked in centimeters (cm), scissors, 4 metal thumbtacks, ceramic magnet, sandpaper, 2 meters 30-gauge, coated magnetic wire, D battery, 20 cm insulated electrical wire, wire cutters, foamcore base to hold the thumbtacks

- o Cut two, 2 cm x 5 cm rectangles from the cookie sheet.
- o For each rectangle, fold the bottom cm at a right angle, to make an L shape.
- o Using a thumbtack, poke a hole 1/2 cm from the top of each rectangle. Both holes need to be at the same height.
- o Place the magnet on the base.
- o Place the L-shaped rectangles on either side of the magnet, with the folded part facing away from the magnet. Thumbtack them down.
- o Use the sandpaper to remove the coating from both ends of the coated magnetic wire. You should remove about 3 cm on each side.
- o Leaving about 5 cm on each end loose, wrap the wire around the D battery. Don't wrap it too tight because you will be taking it off.
- o Once you have a loop, wrap the ends of the wire around to keep it together.
- o Put the loop above the magnet and stick each end of the wire in one of the L-shaped rectangles.
- o Cut the insulated wire in half so that you have two, 10-cm pieces.
- o Strip the coating from the ends of the insulated wires.
- o Wrap the stripped end of the wire around a thumbtack. Do this for each side.
- o Lay the battery on the base and connect one wire to the positive end of the battery and one wire to the negative end of the battery. You can tape one of the wires to one end, but not both.
- o The wire loop should start spinning.



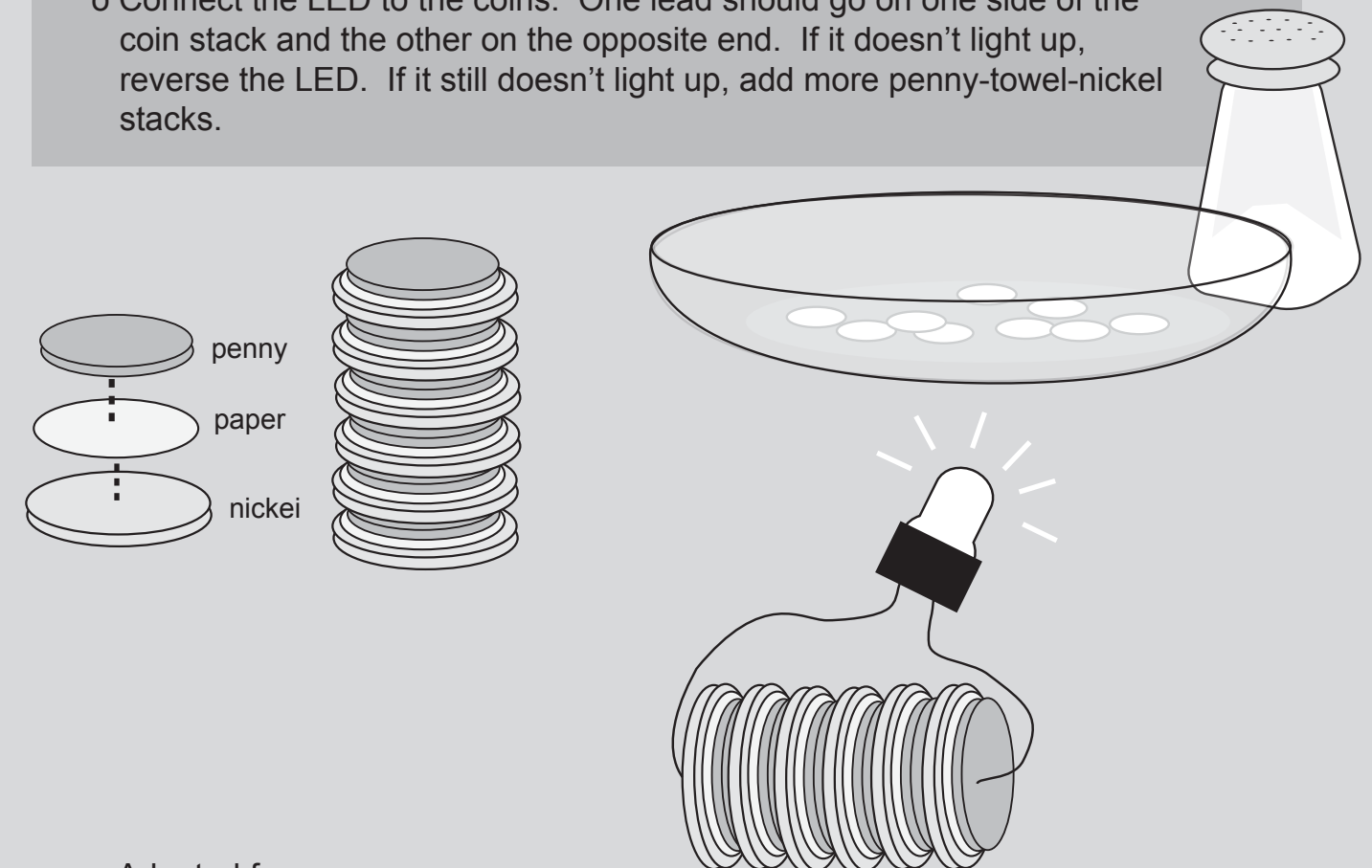
For video instructions, visit <http://www.scienceoffcenter.org/science/421-electric-motor>

Build a Coin Battery

You will need:

small bowl, water, measuring cup, salt, stir stick, thick paper towel, scissors, pencil, at least 6 pennies, at least 6 nickels, very low volt LED (tenths of volts) or voltmeter

- o Add ¼ cup of water to the bowl.
- o Add enough salt to the water so that only a few grains are not dissolved after stirring.
- o Cut 8-10 pieces of the paper towel. The pieces should be big enough to cover a nickel but not go over the edge. You can trace the nickel shape on the towel and then cut it out.
- o Place the pieces into the salt water solution. Make sure you will be able to get them back out again.
- o Lay out 6 nickels and place a piece of the salt-water-soaked towel on each nickel.
- o Place a penny on top of each soaked towel. Be sure the penny does not touch the nickel.
- o Stack the penny, towel, nickel sets on top of each other.
- o Connect the LED to the coins. One lead should go on one side of the coin stack and the other on the opposite end. If it doesn't light up, reverse the LED. If it still doesn't light up, add more penny-towel-nickel stacks.



Adapted from <http://www.how-things-work-science-projects.com/coin-battery.html#>