

STEM in the lab

.....● Inspiring Idaho's future STEM workforce

WIRELESS ELECTRIC CHARGING



GRADE LEVELS

This activity is appropriate for grades 6-10.



VOCABULARY

Inductive coupling uses magnetic fields that are a natural part of current's movement through wire. Any time electrical current moves through a wire, it creates a circular **magnetic field** around the wire. Bending the wire into a coil amplifies the magnetic field. The more loops the coil makes, the bigger the field will be. If you place a second coil of wire in the magnetic field you've created, the field can **induce** (or send a charge) through a current in the wire. This is essentially how an electric toothbrush recharges. This same principle could be used to wirelessly charge EVs.



MISSION

Transfer electricity between two coils to wirelessly light an LED.



MATERIALS

- » 30 gauge magnetic wire
- » Alligator clips with leads (dual sided if possible)
- » 2N2222 NPN-Type transistor
- » Electrical tape
- » Low-power LED
- » Measuring tape
- » Scissors
- » Pliers/wire cutters
- » Battery (9 volt)
- » Cylinder with 2 cm diameter



ABOUT THIS ACTIVITY

One of the biggest challenges with electric vehicles (EV) is keeping the batteries fully charged. Charging EV batteries takes longer than filling a car with gas, and it can be difficult to find charging stations. One way that INL is working to secure our energy future is researching better ways to charge EVs using wireless charging.

INSTRUCTIONS

- 1 Build two coils with the magnetic wire. One will be the inducer, and the other will be the receiver coil.
- 2 Connect the transistor. The transistor is the brain of this operation. Its purpose is to connect and disconnect the power at a rapid pace, thus creating a changing magnetic field in the inducer coil. This changing magnetic field is what induces an electric current in the receiver coil, which powers the LED.
- 3 To properly connect the transistor, you need to attach the correct coil leads to the correct transistor terminals (emitter, base, and receiver). The transistor will be connected using alligator clips.
 - » **Emitter** will go to the negative side of the 9-volt battery.
 - » **Base** will go to one inducer coil lead.
 - » **Collector** will go to the other inducer coil lead.Simply connect alligator clips to the terminal to the leads and wrap with electrical tape to secure and isolate the connection.
- 4 The LED will be also be connected using alligator clips to the two leads of the receiver coil. This allows the LED to be powered easily when the receiver coil is moved around the magnetic field. Each LED terminal will be connected to one lead of the receiver coil. The positive and negative of the led do not matter, as the current in the receiver is changing.
- 5 This experiment is powered by one 9-volt battery. **Emitter** will go to the negative side of the 9-volt battery **Center tap** will go to the positive side of the 9-volt battery.
- 6 Once you have assembled everything and connected the power, hover the receiver coil over the inducer coil and watch the LED light up without wires.



RESOURCES

- » CollinCoil1, & Instructables. (2017, October 10). Simple Wireless Power. Instructables. <https://www.instructables.com/Simple-Wireless-Power/>
- » Wagner, D. J. (n.d.). Introduction to Magnetism and Induced Currents https://www.rpi.edu/dept/phys/SciT/InformationStorage/faraday/magnetism_a.html
- » Wilson, T. V. (2007, January 12). How Wireless Power Works. HowStuffWorks <https://electronics.howstuffworks.com/everyday-tech/wireless-power.htm>

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