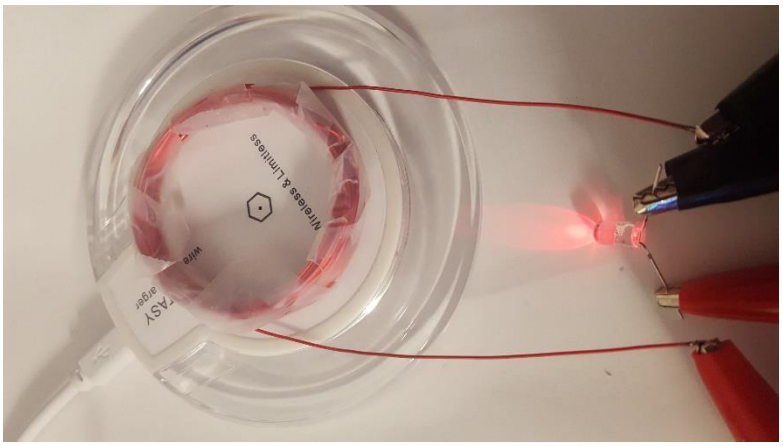
Wireless LED

Materials:

- 12 ½ feet 22 AWG Insulated Magnet Wire
- Wireless QI Charger
- Assorted LEDs
- 4 Centimeter Diameter Cardboard Tube (a Paper Towel or Toilet Paper Roll Tube Should Suffice)
- Clear Scotch Tape
- Fine Grit Sandpaper
- (Optional) Two Alligator Clips
- (Optional) Soldering Iron + Solder



Objective:

Using a wireless QI charger you will explore the relationship between electricity and magnetism. Follow these instructions to create an inductive coil that will allow you to blink an LED wirelessly.

Background:

Wireless cellphone chargers are becoming more common as tech giants strive to add more useful features to their latest devices. What you may not know is that this wireless technology was originally created in the early 20th century by the Serbian-American inventor Nikola Tesla. The devices use an effect called inductive coupling. A very similar principle is used in the transformers found throughout the power grid. Both effects are described by Faraday's law of induction. Briefly, what is happening is that the wireless charger contains a coil of wire. When a current passes through the coil it creates a magnetic field. By switching the direction of the current the orientation of the magnetic field also reverses. Mobile devices designed to be charged through wireless means contain a second coil. When the coil inside your device is placed near the coil inside the charger the changing magnetic field creates or induces a current inside the coil of the mobile device, allowing it to recharge its battery using power harnessed from the charger. Just as a transformer passes power from one coil to another in order to change the voltage level of sections of the power grid, Wireless chargers can pass power to a device which contains a suitable coil.

Instructions for Assembling an Inductive Coil:

1. Find an end of the 12 ½ foot magnet wire. Tape the wire to the cardboard tube so that the wire does not move when you begin to wrap the wire around the tube. Be sure to leave between one and two inches of the wire free. This free end will be used to connect the wound coil to an LED later. You should also be sure to attach the wire near the end of the cardboard cylinder because your coil will need to be placed closely to the wireless charger to work.

2. Wind the magnet wire around the cardboard tube 30 times. Be sure to keep each new coil as close as possible to previously wound coils. If the wire is too far apart the coil will be less affective. Leave the other end of the wire free to connect to the LED and use another piece of tape to hold your coil of wire together. You may choose to slide your coil off of the cardboard tube. The coil will work either way, but if you choose to remove it from the tube be careful not to let it unwind. It is recommended that you wrap tape around the coil in several locations in order to hold it in shape. You may use as much tape as you need as it will not interfere with the operation of the device.

3. Next, use the sandpaper to remove the insulative coating from the two free ends of the magnet wire. Remove about a half of an inch of the coating.

4. Wrap one of the free ends of magnet wire with the insulation removed around each leg of an LED. Because the power from the wireless charger is AC it will not matter which end of wire is connected to the anode or cathode of the LED: the power will alternate flowing in both directions and the LED will light up when the current flows through it in the correct direction and it will turn off when the current flows in the other direction. You may wish to tape the wire to the LED or solder them together to create a more reliable connection, but it is not required to make it work. Alternatively you can use alligator clips to connect the legs of the LED to the free ends of the coil.

5. Follow the instructions included with your wireless QI charger to set the device up for use.

6. Place your coil over the center of the wireless charger. The LED should begin to blink. The LED does not stay on because the wireless charger is designed to only generate a constant supply of power when it detects a device that it is designed to charge. The blinks happen when the charger sends out a pulse, searching for such a device. Because our coil can't send back an appropriate response pulse, the charger will not send it constant power. If you were to view the LED in slow motion you would see that each pulse from the charger actually causes the LED to blink several times very quickly because the signal from the charger is AC.

Exploration:

- What happens when you hold the coil further above the wireless charger? Does the LED still blink? Does it blink as brightly?

- If you have a device which is designed to charge wirelessly, try setting it on the wireless charger so that it begins charging, then quickly remove your device and replace it with your coil. What do you notice?

- How do you think the diameter of the coil affects its ability to light the LED? What about the number of coils or the size of the magnet wire? Using whatever materials you have, try to test your ideas.