

# Exercises

## Lesson 1: Circuits and Components

1. LED stands for Light Emitting Diode. Does it matter which way you wire it up in a circuit? Does the longer wire on the LED connect to plus (red) or minus (black)?
2. Do you need to hook up batteries to make a neon lamp light up? What are two different ways you can make a neon lamp light up?
3. If you want to reverse the spin direction of a motor without using a switch, what can you do?
4. A simple switch can be made out of what kinds of materials?
5. Name six materials that are electrically conductive.
6. What's the difference between a light bulb and your LED?

7. What happens when you rub your head with an inflated balloon? Which charge is where?
8. Why do electrical charges move in a circuit?
9. What makes lightning?
10. What's the charge of an electron?
11. What happens when you split an electron open?

# Exercises

## Lesson 2: Robotics

1. Draw how you can connect a buzzer, LED, battery pack, and motor together AND have them all work at the same time.
2. How can you make a motor that's already wired up in your circuit go *faster*?
3. What does a DPDT switch do? Draw six dots (like the six on a die). These are the six terminals on your DPDT switch. Using your diagram, draw how you would connect the DPDT switch so that it can turn the motor on and off, as well as reversing it.
4. Can you use the same electrical circuit for the underwater robot as the laser light show? Why/why not?

5. Why does a pressure sensor work?
7. Name three ways you would improve the Jigglebot Robot.
6. What kind of switch is a trip wire?

## Answers to Circuits & Components Exercises

1. Yes, the longer lead is positive, and the side of the LED plastic housing that has a straight edge is negative.
2. No batteries required. The neon lamp requires very few amps, but high voltage to illuminate, which you can get by charging yourself up. Simply hold one lead and scuff along the carpet and touch the other lead to your cat's nose. Or hold one lead and slide down a non-metal slide. Poof!
3. Switch the wires on the back of the motor at the terminals.
4. Take the two wires (one from the battery and the other from the motor) and touch them together – ON – OFF – ON – OFF. Simplest switch in the world! But you can also use index cards, paper clips, and brass fasteners. Clothespins work great, too.
5. Soda cans, quarters, paper clips, braces, unpainted eyeglasses, and your tongue.
6. A light bulb works both ways when you connect it into a circuit, an LED is polarized (only works one way).
7. Blow up a balloon. If you rub a balloon on your head, the balloon is now filled up with extra electrons, and now has a negative charge. The balloon is negatively charged.
8. There's an imbalance of charges when you hook up a battery, causing the electrons to zip around the circuit.
9. There's an imbalance of charge when lightning strikes. It's the same thing as when you scuffed along the carpet, gathering up electrons in your body, only the lightning has a *lot* more charge.
10. Negative.
11. Nothing—an electron is as small as you can get, at least, as far as we know now.

## Answers to Robotics Exercises

1. Connect the LED, motor, and buzzer in parallel (plus to plus) and they should all work.
2. Add a second battery pack to your circuit.
3. A DPDT switch allows you to reverse the motor direction by reversing the flow of electrons.
4. Yes, they both use the same circuit, including the motor speed control circuitry. They both need to control the speed and direction of the motors, and the electrical circuit doesn't care whether you have a mirror or propeller on your motor shaft.
5. The sponge separates the foil, breaking the circuit open. When you squish the foam, the foil pieces touch and your light bulb lights up.
6. The trip wire is a normally closed (NC) switch.
7. I'd add headlights (LEDs), a horn (buzzer), and a wired remote control. How about you?