Project 1: Light

New Components Introduced in This Project

Each of the components listed below will be described in more detail as you progress through each project.

- LEDs
- Resistors
- Potentiometers
- Photoresistors

New Concepts Introduced in This Project

Each of the concepts listed below will be described in more detail as you progress through each project.

- Polarity
- Ohm's Law
- Digital Output
- Analog vs. Digital
- Analog Input
- Analog to Digital Conversion
- Voltage Divider
- Pulse-width Modulation
- Functions

You Will Learn

- How to upload a program to your Arduino Uno
- Circuit building basics
- How to control LEDs with digital outputs
- How to read sensors you analog inputs

Parts Needed

Grab the following quantities of each part listed to build this circuit:

New Components

LED (Light Emitting Diode)

Light-Emitting Diodes (LEDs) are small lights made from a silicon diode. They come in different colors, brightnesses and sizes. LEDs have a positive (+) leg and a negative (-) leg, and they will only let electricity flow through them in one direction. LEDs can also burn out if too much electricity flows through them, so you should always use a resistor to limit the current when you wire an LED into a circuit.
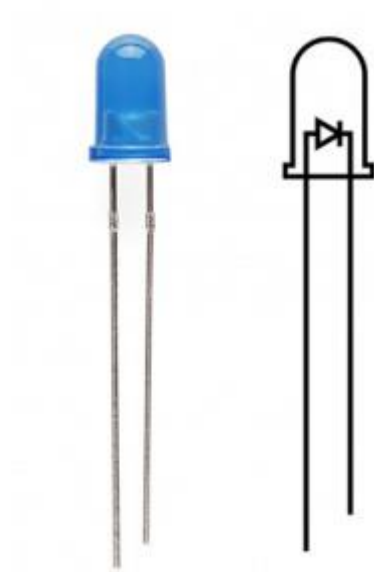
Resistors

Resistors resist the flow of electricity. You can use them to protect sensitive components like LEDs. The strength of a resistor (measured in ohms) is marked on the body of the resistor using small colored bands. Each color stands for a number, which you can look up using a resistor chart.

New Concepts

Polarity

Many electronics components have polarity, meaning electricity can only flow through them in one direction. Components like resistors do not have polarity; electricity can flow through them in either direction. However, components like an LED that do have polarity only work when electricity flows through them in one direction.

Ohm's Law

Ohm's law describes the relationship between the three fundamental elements of electricity: **voltage**, **resistance** and **current**. This relationship can be represented by the following equation:

$$V = I \cdot R$$

Where

- V = Voltage in volts
- I = Current in amps
- R = Resistance in ohms (Ω)

This equation is used to calculate what resistor values are suitable to sufficiently limit the current flowing to the LED so that it does not get too hot and burn out.

Digital Output

When working with microcontrollers such as the Arduino Uno. there are a variety of pins to which you can connect electronic components. Knowing which pins perform which functions is important when building your circuit. In this circuit, we will be using what is known as a **digital output**. There are 14 of these pins found on the RedBoard and Arduino Uno. A digital output only has **two states**: **ON or OFF**. These two states can also be thought of as **HIGH or LOW** or **TRUE or FALSE**. When an LED is connected to one of these pins, the pin can only perform two jobs: turning the LED on and turning the LED off. We'll explore the other pins and their functions in later circuits.

Hardware Hookup

We recommend familiarizing yourself with each of the components used in each circuit first.

Polarized Components ⚠	Pay special attention to the component's markings indicating how to place it on the breadboard. Polarized components can only be connected to a circuit in one direction.

Pay close attention to the LED. It is polarized. The negative side of the LED is the short leg, marked with a flat edge.

Flat Edge

Short Leg

—

+
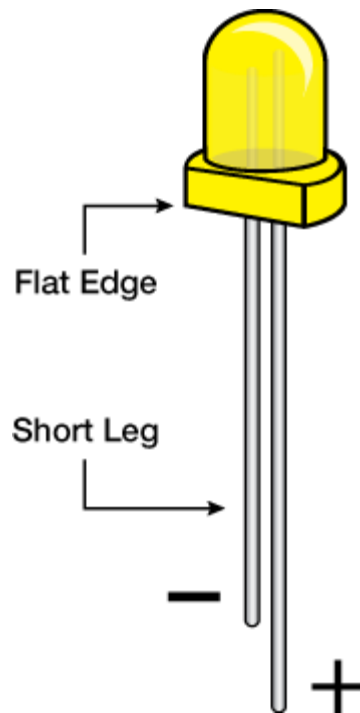
Components like resistors need to have their legs bent into 90° angles in order to correctly fit the breadboard sockets.
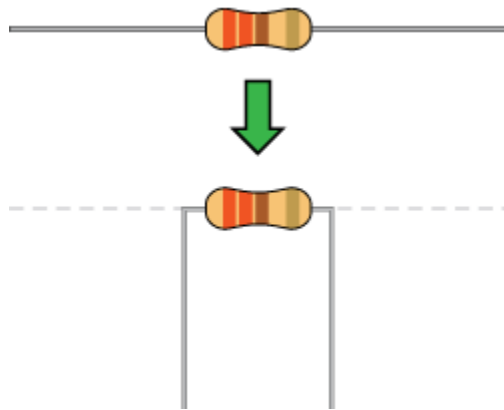
Ready to start hooking everything up? Check out the circuit diagram and hookup table below, to see how everything is connected.

Circuit Diagram

Circuit Diagrams: SparkFun uses a program called Fritzing to draw the circuit diagrams you see throughout this guide and throughout all of our online guides. Fritzing allows us to create diagrams that make it easier for you to see how your circuit should be built.
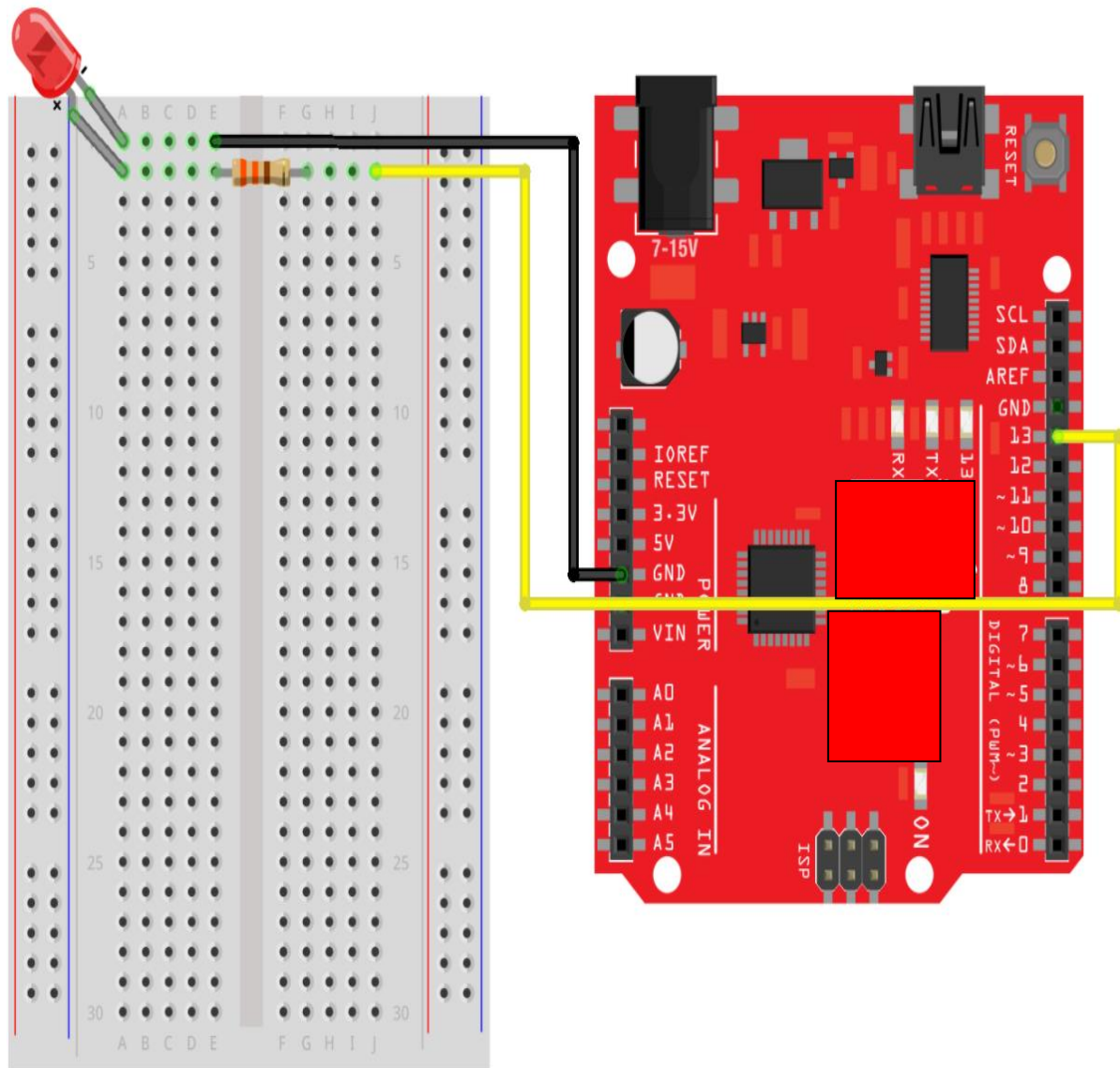
Component	RedBoard	Breadboard	Breadboard
LED ⚠		A1 LED (-)	A2 LED (+)
330Ω Resistor (orange, orange, brown)		E2	F2
Jumper Wire	GND	E1	
Jumper Wire	Digital Pin 13	J2	

```
void setup() {

  pinMode(13, OUTPUT);     // Set pin 13 to output

}


void loop() {

  digitalWrite(13, HIGH);   // Turn on the LED

  delay(2000);             // Wait for two seconds

  digitalWrite(13, LOW);    // Turn off the LED

  delay(2000);             // Wait for two seconds

}
```