James C., Meshal, and Kyle Y.

Building a Circuit

- 6. If we connected a 1Ω resistor between these two rows - so that it is in a closed loop with the 5V supply from the Rpi, how much current would this circuit attempt to draw across the resistor? **We expect the circuit to have a current of 5 Amps across the resistor**
    - a. The Rpi adaptor provides 5V and up to 2 Amps, is this current sufficient? **It is not sufficient as the circuit will draw more current than the power adaptor will allow for**
    - b. What do you think might happen? Please don't actually do this. **This will not only break through the power adaptor but also cause the resistor to burn up as it pulls way too much current**
- 7. Connect a resistor of more than at least 100Ω (Why might this be enough resistance?) **This would mean the circuit would only pull 50 mA or less which is considerably less and does not break the resistor**
    - a. If you have a multi-meter able to measure current, evaluate the current across the resistor, is it what you expected? **With a resistor of 120 Ohms, we measured a current that continued to fluctuate but we should have had a current of 41 mA. This is likely due to unstable connections and human error with the board**
        - i. NOTE: to measure current, you have to put the meter in series with the rest of the circuit – it cannot measure current like it would voltage (connecting leads to +/- side of a component) – the current has to run through the meter

LED in a Circuit

1. Add an LED to your circuit
    a. Put it in series with the resistor and move the +/- connectors to the RPi 5V supply as needed **Done**
        i. How does the diode need to be oriented? Which wire on the LED goes to the +5V side and which goes to the GND connector? **It needs to be oriented so that the positive side goes toward the 5V side and the cathode goes towards the GND connector. This way, current flows through it**
    b. What is the voltage drop across the resistor? Was this what you expected? **We found it was 2.88 V. which fit our expectations**
    c. What is the voltage drop across the LED? **It was about 2.12 V which matches since the total voltage drop should be -5 V**
2. Try removing the resistor from the circuit, keeping the circuit closed - the LED is just in series with the 5V supply.
    a. What do you think will happen to the LED brightness? **It should be brighter since the brightness is determined by the current flowing through it unless the current is too much and the diode stops behaving like a diode.**
3. Try including resistors of different values - how does LED brightness change vs resistor strength? **As the Resistor increases in strength, the LED gets darker**
    a. Do the voltage drops across the resistors and LED change? **Yes they do, the voltage drop across the resistor is bigger, and it is smaller across the LED**
4. Using the configuration with the highest LED brightness now move the 5V connection on the RPi to one of the 3.3V pins.
    a. What do you expect to happen to the LED brightness? **We expect it to get darker since the Voltage drop across the LED gets smaller as the voltage of the power supply decreases.**
5. Add a step-up circuit components to increase your RPi voltage from 5V to 10V but do not close your circuit yet
    a. Using the dimmest configuration for the LED explored previously (meaning select the appropriate resistor from those you tried previously) now
    b. How will the LED brightness change? **It increased in brightness compared to the 5V power supply with the higher resistor**
6. How would you quantify the LED brightness changes? **LED Brightness changes proportionally to the voltage drop across it.**
7. Do any of these results change with different color LEDs? Specifically do any voltage drop values change, is the relative brightness similar for different color LEDs, etc. **It depends on the rating of the bulb, but it is brighter for bulbs that have higher internal resistance**

Photo Diode

- 1.Replace the LED with a photo-diode (remove the step-up component as well if you had one included previously)
    - a. NOTE: photo-diodes operate in reverse bias mode so you will need to orient the diode accordingly
- 2. What is the voltage across the resistor when you simply connect the 5V supply to close this circuit?
    - **The voltage around the resistor is close to 0.45 V**
- 3. What happens if you cover the photo-diode? What happens if you change the +connector to go to the 3.3V pin on the Rpi? **When we cover the photo-diode, we see the voltage drop significantly. We see similar effects when we lower the voltage**
- a. What is the dark current for this photo-diode? (Use the voltage across the resistor to determine diode current)
    - **We find the dark current to be 0.00212 mA**
- b. Is 5V enough supply voltage to see a signal from this diode? Is 3.3V?
    - **We found 5V to be enough to see a signal but found that 3.3 was barely enough to find anything**
- c. What happens if you attach the step-up circuit component to increase the supply up to 10V?
    - **After attaching the 10V, we still saw a very small voltage drop across the resistor**
- 4. What are the dark current and saturation current for the photo-diode?
    - **We found the dark current to be 0.002mA and the saturation current to be 1.9 mA across the circuit**