iDesign Studio ~ Lab 1: Breadboard

The basic breadboard - how does it work and what is it useful for?

Materials list

<table>
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<tr>
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<th>Notes</th>
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<tbody>
<tr>
<td>1 Breadboard</td>
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<tr>
<td>4 LED lights</td>
<td></td>
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<tr>
<td>1 push button</td>
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<tr>
<td>8 short wires</td>
<td>4 red, 4 black</td>
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<tr>
<td>2 long wires</td>
<td>1 red, 1 black</td>
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<tr>
<td>3V battery</td>
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<tr>
<td>bit of electrical tape</td>
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**Caution:** It’s pretty hard to break a breadboard or LED, but... you could easily drain your battery!

**DO NOT CONNECT YOUR POSITIVE AND NEGATIVE SIDES!**

*Doing so (with wires or the breadboard conductors) will cause all the charge to travel from the positive to negative sides. And you’ll be left with a dead battery 😞*

Part 1: Testing an LED with a battery

- LEDs can tolerate up to 3 volts. After that, a resistor is needed (we will talk about these later in the semester).
- An LED has a positive side and a negative side. The negative side has a shorter lead. It also has a larger metal piece inside the head of the LED. Sometimes the head of the LED will also have a dent in the side to signal which lead is negative. Electrons move from the negative side of the LED to the positive side.
- In order to light an LED, we have to match the leads of the LED to the sides of a battery.
- Hold the correct leads of your LED to the sides of your battery – it should light up!
- Now try switching so that the positive lead is touching the negative side of the battery and vice versa – what happens?
Part 2: Getting to know your breadboard

- The name “breadboard” comes from a time when electronic circuits were built on wooden boards that were literally for cooking and cutting bread!
- Columns on a board are marked with letters A-J. The left side of the board has letters ABCDE and the right has FGHJ. These two sides are not connected. The board’s rows are marked with numbers (yours will be labeled 1 - 30).

- Looking at just one side of columns (ABCDE or FGHJ):
  - The inside of the breadboard has metal conductors for every row. These metal conductors connect the five holes for that row.
  - If a wire were placed in any hole of the left side (ABCDE) of the breadboard in row 20, it connects 5 holes. That means that position 20A-20E would all be linked.
    Note: Since the left side and the right sides are not connected, positions 20F-20J are not connected to 20A-20E.
Part 3: Using your breadboard to light an LED

- Place an LED on your breadboard with
  - the positive lead in 10E
  - the negative lead in 10F
- Connect positive
  - Take your long red wire and use a little electrical tape to attach one end to the positive side of your 3V battery
  - Place the other end of the wire into hole 10A
- Connect negative
  - Take your long black wire and use a little electrical tape to attach one end to the negative side of your 3V battery
  - Place the other end of the wire into hole 10J
- Your LED should light up!
- But... if your LED doesn't light:
  - Check to make sure the positive and negative leads are not reversed.
  - Check that the electrical tape is creating a good connection with your 3V battery (or squeeze it with your fingers)!
- Notice that you can place the positive battery wire or positive lead in any of the 5 holes, and the LED will shine. Placing a battery wire in a separate row from the LED will cause it not to, breaking the circuit.
- About wire colors: conventionally, negative wires are black or blue, and positive wires are red. However, the wires themselves are identical. Stick with conventional colors for good design practice!
  ...and save yourself some confusion...

Part 4: Setting up a shared power supply
Now we move on towards adding more LED lights. To do this we must be able to connect all the LEDs to the battery supply.

- Your breadboard has two columns (with red and blue lines) located on each of the left and right sides. The holes that appear along those lines are intended to be used as power lines; a long metal conductor runs under each column of holes.
- To take advantage of the labels, we will always use the holes closest to the red lines are for positive voltage and the blue for negative.
- Begin by removing the battery wires from 10A and 10J. Instead, we are going to put the negative battery wire by a blue line and the positive wire by a red line. Remember, it doesn't matter what hole the wires are placed in because a strip of holes is connected.
- For organization, choose the top or bottom as the place to connect your power wires.
  - Connect the positive (red) wire to the leftmost column
  - Connect the negative (black) wire to the rightmost column
Step 5: Lighting LEDs

- Connect your LED (still in row 10)
  - Use a short red wire to connect from the positive column to 10A
  - Use a short black wire to connect from the negative column to 10J
  - Your LED should light!
- Now add 3 more LED lights:
  - Add two more by doing the following for each:
    - choose a new row
    - connect the LED as you did with the first LED using
      - 1 short red wire and
      - 1 short black wire
  - For the last LED, connect it using two rows and the same column set
    - choose the left or right side and a pair of sequential rows within
    - for example, hole sets 20A-E and 21A-E
    - connect the positive:
      - connect the positive column to one of the rows with a short red wire
      - place the positive lead in one of the other 4 holes in that row
    - connect the negative:
      - connect the negative column to one of the rows with a short black wire
      - place the negative lead in one of the other 4 holes in that row

Step 6: Adding a button

- The schematic above depicts how the push button works.
- How would you modify the circuit diagram to have your last LED light only when the button is pressed?
  - Use the breadboard to implement and test your modification.
- Now how would you modify the circuit diagram to have all your LEDs light only when the button is pressed?
  - Use the breadboard to implement your modification.
Step 7: Designing an LED business card
Get creative by designing your own business card. Your design must incorporate:

- at least 4 LEDs
- 1 push button

As you creating your design, keep track of:

- things that went well
- things that were tricky
- things you wanted to do, but couldn’t figure out

We’ll talk about everyone’s designs on Monday!

Written by: Shani Mensing, Nicole Hoffler, Audrey St. John
Adapted from https://www.youtube.com/watch?v=k9jcHB9tWko
# Worksheet

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<th>Draw the 4 LED circuit here:</th>
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<th>Draw the circuit with the push button for only the last LED</th>
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<th>Draw the circuit diagram for your business card</th>
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