

Mystery Series & Parallel Circuits

Jeff Bigler

MrBigler@MrBigler.com ; BiglerJ@LynnSchools.org

Attribution

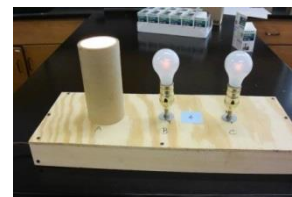
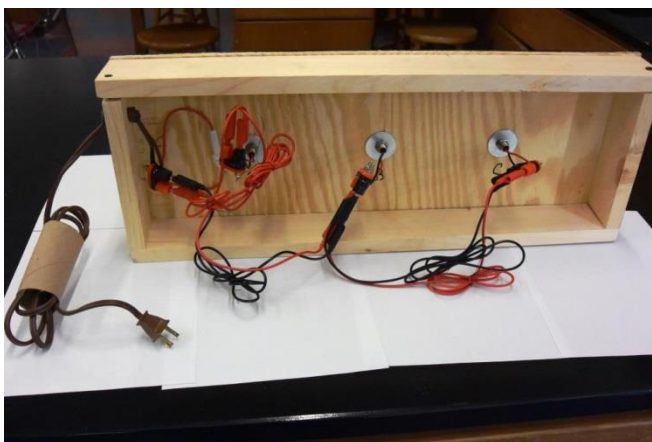
This activity was designed by Barbara Watson, physics teacher, Richardson Independent School District, Richardson, Texas, and was presented by Ms. Watson at several AP Summer Institutes.

Overview

Boxes are built to hold three or four light bulbs, such that the bulbs can quickly and easily be wired in complicated series/parallel circuits using wires with banana plugs. Circuits are wired prior to the activity, and students must derive the circuit diagram by turning individual bulbs on and off and observing what happens.

Design & Construction

Each box is wired with a power cord, an inline 10A fuse, and 3 or 4 light sockets with push-through on/off switches. The power cord and each socket are wired with a set of banana connectors. Identical light bulbs are screwed into each of the sockets.



The box is constructed such that a circuit can be wired by simply plugging leads with banana plugs into the appropriate connectors.

Materials

The following supplies were purchased and used to make six boxes, three with three sockets, and three with four sockets. Prices were current when the boxes were constructed, in 2016.

Lighting Hardware was purchased from Professional Hardware & Supply, <http://www.profhdwr.com>

Qty.	Item	Unit Price	Total Price
25	Push-Thru Gilt Finish Socket	1.89	47.25
1	100/pk 1/8 IPS 9/16 in. Steel Nuts	4.99	4.99
1	100/pk - 2 in. x 1/8 IPS All-Thread Pipe	8.49	8.49
1	100/pk Flat Washers 1½ OD 1/8 IPS Slip Z	10.99	10.99
1	100/pk Shake Proof Lockwashers 1/8 IPS Slip Z	3.99	3.99

Electronics hardware was purchased from Marlin P. Jones & Associates, Inc. (MPJA, Inc.), <http://www.mpja.com>

Qty.	Item	Unit Price	Total Price
30	Test Lead, 1m, Stackable Banana Plugs, Black	1.49	44.70
40	Test Lead, 1m, Stackable Banana Plugs, Red	1.49	59.60
40	Dual Binding Post, Panel Mount	1.50	60.00
5	10-Amp, 250V 3AG Fuse, Pack of 10	0.99	4.95
8	Fuse Holder, In-Line for AGC,3AG Fuse	0.60	4.80

Light bulbs were purchased from <http://www.bulbs.com>

Qty.	Item	Unit Price	Total Price
48	Bulbrite 29 Watt, 120 Volt Halogen A19 Soft White Bulb	1.99	95.52

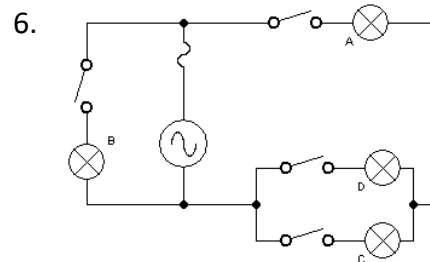
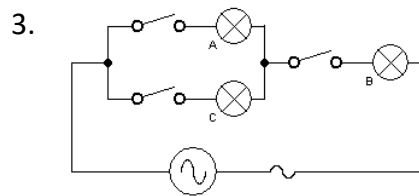
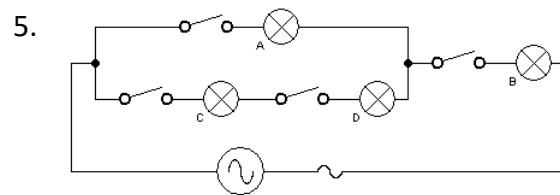
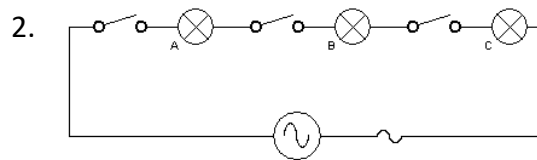
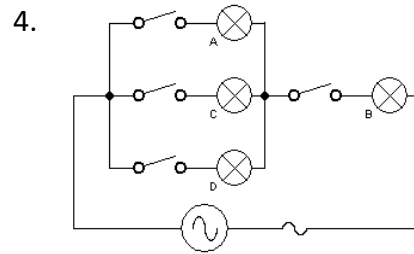
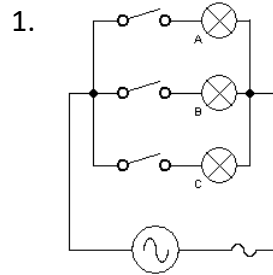
Demonstrations

With identical bulbs, the boxes can be used in lecture/discussion to show the behavior of multiple bulbs in series vs. parallel vs. mixed series/parallel.

Multiple boxes can be pre-wired in series, parallel and mixed series/parallel. Students can observe the wiring and predict the behavior as each bulb is turned on or off.

Lab Experiment

As mentioned above, I have six boxes; three with 3 sockets and three with 4 sockets. I pre-wire them in the following configurations:



Students are tasked with deriving the correct arrangement and drawing a diagram for each circuit, only by turning individual bulbs off or on and observing what happens.