Know Your Bulbs!

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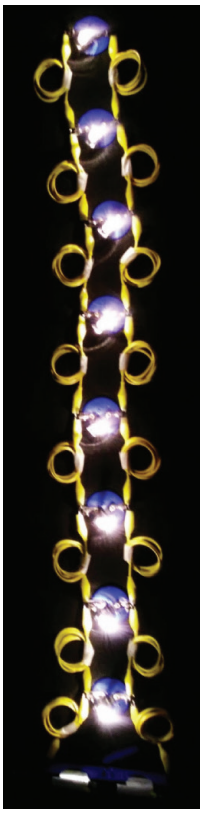
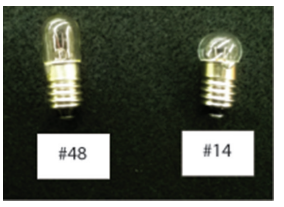
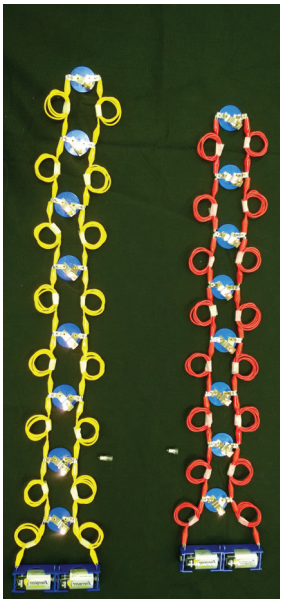
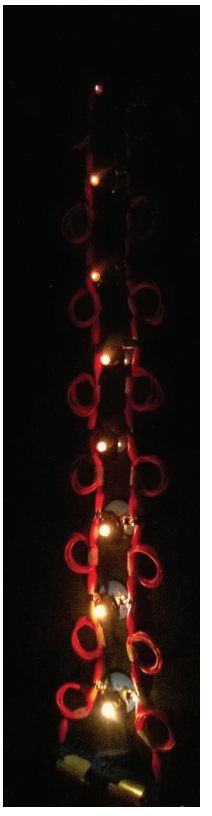


#48 bulb		
Δ*V*(*V*)	I (mA)	R (Ω)
2.41	69.2	34.8
2.43	68.2	35.6
2.45	69.4	35.3
2.48	70.4	35.2
2.51	71.5	35.1
2.56	72.9	35.1
2.60	73.1	35.6
2.65	72.9	36.4
2.82	556	





#14 bulb		
Δ*V*(*V*)	I (mA)	R (Ω)
0.968	185	5.23
1.00	188	5.32
1.04	194	5.36
1.12	198	5.66
1.19	206	5.78
1.30	213	6.10
1.42	216	6.57
1.67	228	7.32
1.93	1535	



Here we show eight standard instructional #48 and #14 bulbs from the Modeling and CASTLE physics curricula connected in parallel with two D cells using typical inexpensive alligator leads whose resistances are ~ 0.09 Ω /wire. The central photos are for reference purposes in regular light, and the outer photos and tables show relative brightnesses, measured voltage drops, and currents with calculated resistances for each adjacent bulb. Final table entries show the voltage drop and current through the battery.

The far lefthand circuit is constructed with #48 (a.k.a. long) high resistance bulbs, whose resistance is about 350 times greater than any single lead, so $R_{long} >> R_{leads}$, and the circuit is pedagogically well behaved. The far righthand circuit is constructed with #14 (a.k.a. round) low resistance bulbs, whose resistance is only 60 times greater than any single lead, so $R_{16leads}$ becomes comparable with R_{round}, and the circuit behavior is not as pedagogically simple.

We believe teachers require both higher and lower resistance bulbs for good circuits pedagogy. However, teachers should take care not to inadvertently mix bulbs of different resistances, manufacturers, and batches so as to inappropriately introduce more variables than intended, particularly in early lessons. We suggest teachers use high resistance bulbs for most purposes and purchase bulbs in bulk, using the final few bulbs for student projects when replacing stock.