



***Understanding the LED
Design Using Modern
Engineering Tools***

Table Set-up with Modern Engineering Tools

Target Audience: Parents of elementary school students (grades 3-6) and Middle and High School Students

Objectives:

1. Introduce LED technology and design by using the USB Microscope.
2. Introduce the LED and bulb as an efficient alternative to conventional light bulbs.
3. Introduce the Mobile Studio as an example of a modern engineering measurement tool
4. Provide hands-on experience with the measurement of the time-dependence of light output from LED bulb.
5. Provide interaction with engineering students.

BOM:

USB Microscope and Mobile Studio with a computer (one for each table), a simple LED circuit with LED, 9V battery, potentiometer to manage LED brightness, coin, a semiconductor wafer sample if available (very expensive) and Two handouts; the LED schematic diagram and picture of a 40 lumen equivalent LED bulb (cluster of single LEDs) attached, the Lamp specifications spreadsheet as a reference for a variety of standard bulbs available from national chains (e.g. Lowes and Home Depot) attached, including price, lumen output, predicted hours of operation.

Item	Source / Website	Price
USB 1.3 Megapixel Digital Microscope	http://www.thinkgeek.com/gadgets/electronic/9955/	\$349.00 each
Mobile Studio	RPI - http://mobilestudio.rpi.edu/	Approx. \$150.00
LED Simple Circuit: see below for components		
Bread board w/ wires	Electronic Express part # 03MB101 3.3" x 1.8"	Approx. \$2.70
Resistor Kit (incl. 470K)	Electronic Express Jumper Wire for breadboards Part No. 2700RJW90	Approx. \$16.95 / bundle
	Electronic Express Part No. 13RK2501	Approx. \$ 6.75 each set
Potentiometer	Electronic Express part # 18STS value	Approx. \$.90 each
9 Volt battery	Allied Electronics Item # 774-0240 Dantona Industries, Inc.- Part # LLG-9V G6F22 battery; Carbon Zinc 9V	Approx. \$.43 each
9 Volt Battery Snap	Electronic Express Part No. 2801BSI	Approx. \$.25 each small quantities
LEDs	Electronic Express Super Bright LED 5 mm Red, Green, Yellow, Blue, Amber Part # 08LCH – color designation	Range - \$.20 - \$1.10 each

Set Up: For a round table, set up the USB Microscope and Mobile Studio with a computer (one for each table) in a central location so that the microscope and Mobile Studio board can be accessible. Include several copies of both handouts described above, coin and semiconductor wafer.

Activities:

1. Introduce mentor (s) and general purpose of activities.
2. Introduce the USB Microscope as a modern instrument and use a typical coin as the specimen.
3. Describe the LED simple circuit components and specifically bring attention to the design of the LED.
4. Discuss the technology behind the LED bulb and the attributes – reduced energy to support brightness.
5. Examine the LED under the USB Microscope

Outcomes:

1. Audience will be better informed about a cutting edge technology and how it improves our world.
2. Audience will be able to provide an example of how engineers approach problem solving and/or the development of a new product.
3. Audience will be better able to understand and appreciate the other activities offered at the event, especially the one on the color of light.
4. Audience will have an increased understanding and enthusiasm for what engineers do and for an engineering career.
5. Audience will visit the website of the Smart Lighting ERC.

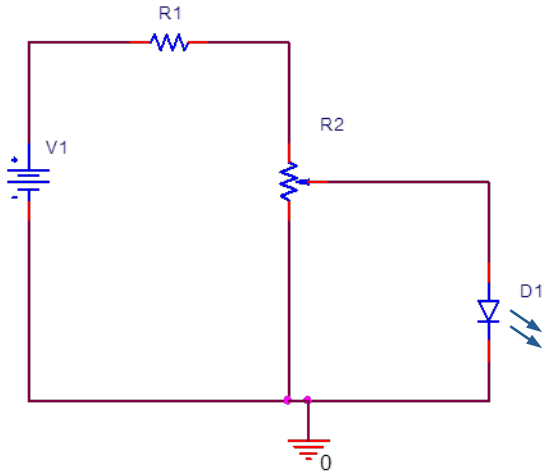
Takeaways:

Either a handout (attached) with the list of online information, light bulb specifications, etc. or a single link to all information online. The latter is preferred as a mechanism for encouraging the interested public to visit the website of the Smart Lighting ERC. The link provided should also help connect the audience to information on engineering, engineering careers, and K-12 STEM education.



Resources:

The major resources required for mentors or for self-guided exploration are included in the handouts with diagrams and microscope except for instruction on how to use the Mobile Studio. This information is available on the Mobile Studio Project website mobilestudioproject.com. It is assumed that the mentors are engineering students, preferably from Electrical Engineering or practicing EEs. However, anyone with some practical experience in electronics can also be a mentor.



LED Simple Circuit Design

V1 is a 9V battery

R1 is the current limiting resistor (can be 200-500 Ohms)

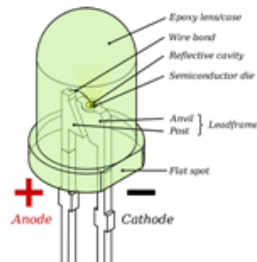
R2 is a potentiometer (1k works well, but 5k and 10k can also be used)

D1 is the LED

Battery manufacturer	Type of Light and brief description if unique	# of bulbs	Price/ pack	Price / bulb	Retail Store	Date of purchase	Light Output Lumens (brightness)	Voltage (Volts)	Energy Used	Estimated Life (hours)	Claim to fame
GE	Compact fluorescent disguised in globe	1	6.46	6.46	Lowe's	2/15/2011	400	120	11 watts	10000	\$39 in energy savings per bulb and lasts 15 years
Philips	Dimmable halogen floodlights	1	4.97	4.97	Home Depot	2/15/2011	420	120	45 watts	3000	Can replace similar incandescent floodlights while using less power and having a greater light output
Sylvania	Long lasting soft white incandescent light	8	4.98	0.62	Lowe's	2/15/2011	390	120	40 watts	1500-4000	A cheap and reliable light source for frequently used light fixtures
Ecosmart	Soft white compact fluorescent	4	5.85	1.46	Home Depot	15-Feb	550	120	9 watts	10000	Cheap, bright, and long lasting
Philips	Small long lasting fluorescent that fits mor	4	7.98	1.99	Home Depot	2/15/2011	500	120	9 watts	12000	A long lasting and efficient fluorescent that is smaller in size
Feit Electric	High-output LED light	1	18.98	18.98	Lowe's	2/15/2011	340	120	6.5 watts	30000	\$121 in savings per year and 30 years of continuous usage
Sylvania	Extremely long lasting LED light	1	21.98	21.98	Lowe's	2/15/2011	430	120	8 watts	50000	Lasts 33 times longer than average incandescent light with 5.7 years worth of continuous usage
Sylvania	Soft white halogen light	4	7.18	1.8	Lowe's	2/15/2011	455	120	28 watts	1000	Energy efficient halogen light at only 28 watts
Ecosmart	Dimmable LED light	1	17.97	17.97	Home Depot	2/15/2011	429	120	9 watts	50000	Extremely long lasting and dimmable
Philips	Soft white incandescent light	4	1.27	0.32	Home Depot	2/15/2011	500	120	40 watts	1000	Very affordable light source
Philips	White light LED light	1	21.97	21.97	Home Depot	2/15/2011	450	120	8 watts	25000	Very long lasting dimmable LED light
dated 2/19/11											



Light Emitting Diode - LED



• One Diode



Thirty-eight (38) Diodes