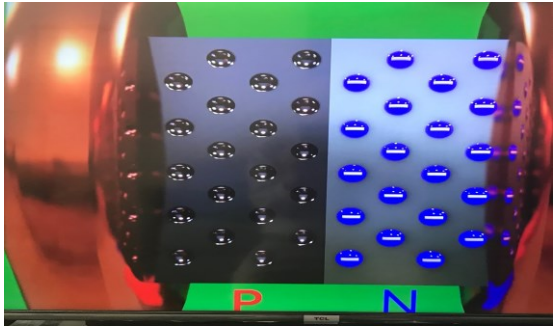
LED Lighting

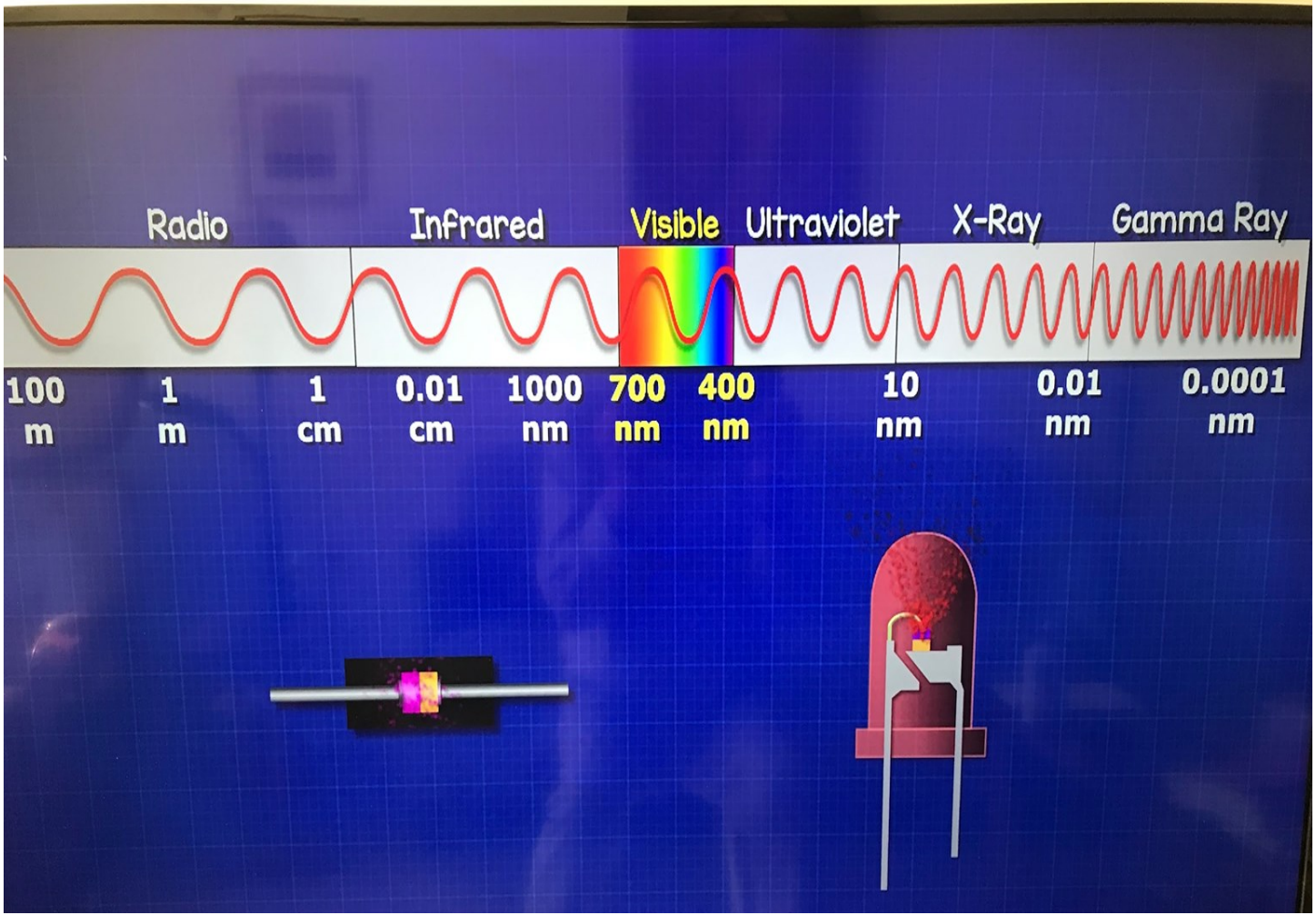
Presentation

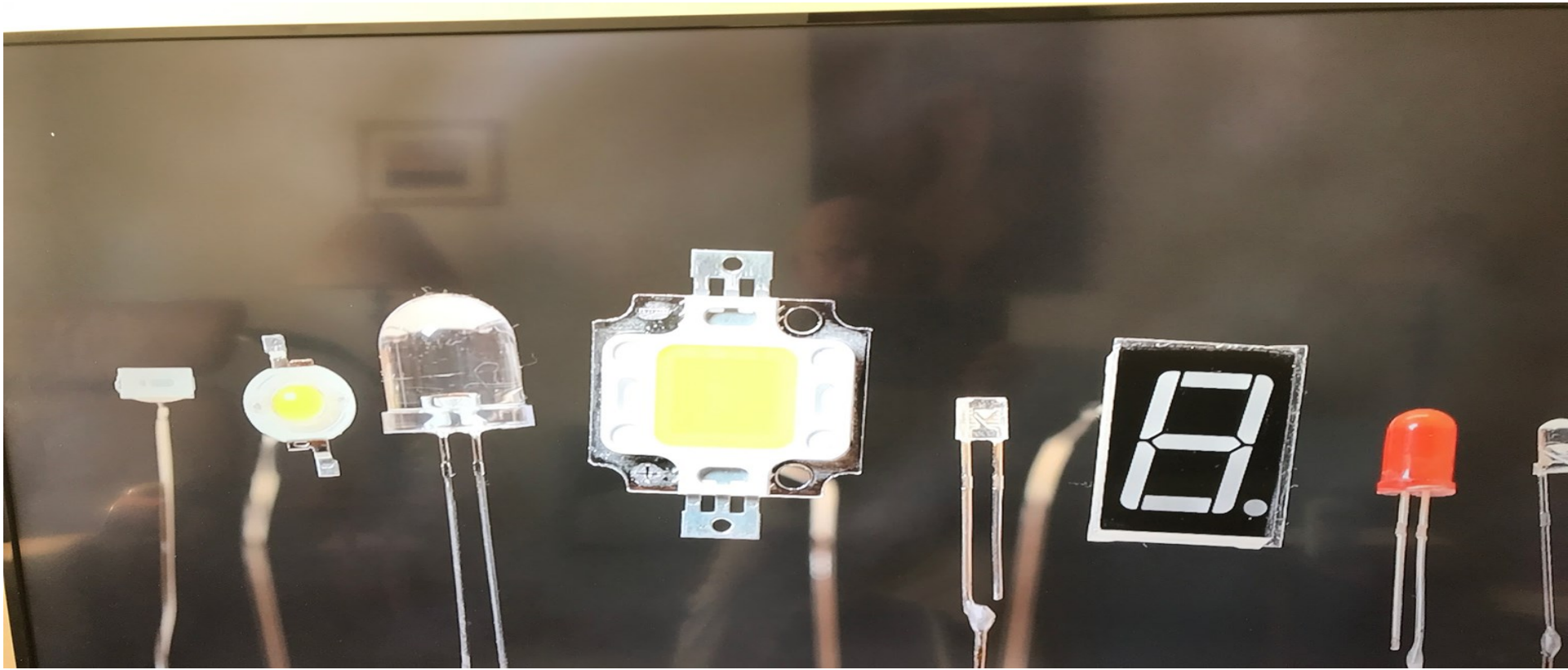
P N MATERIAL
BETWEEN CONDUCTORS

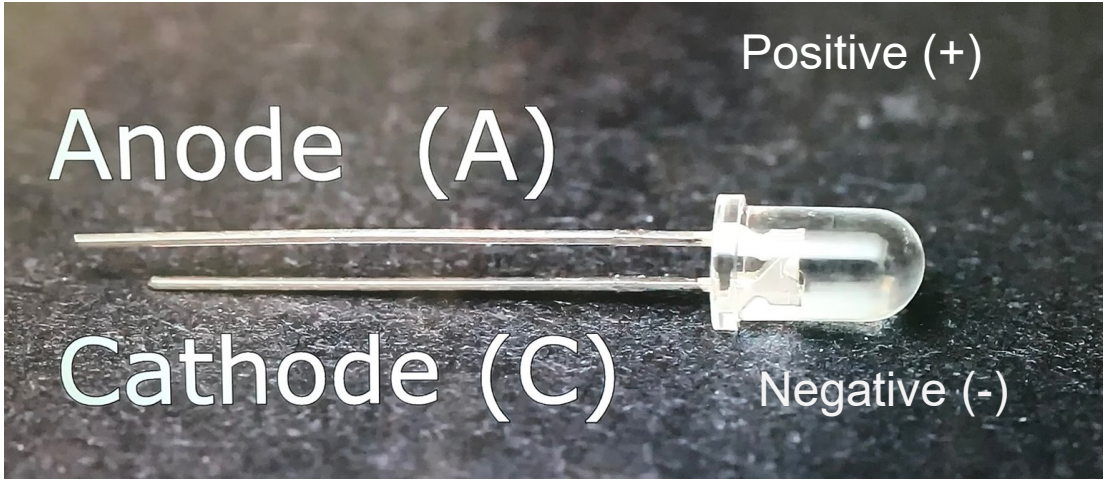


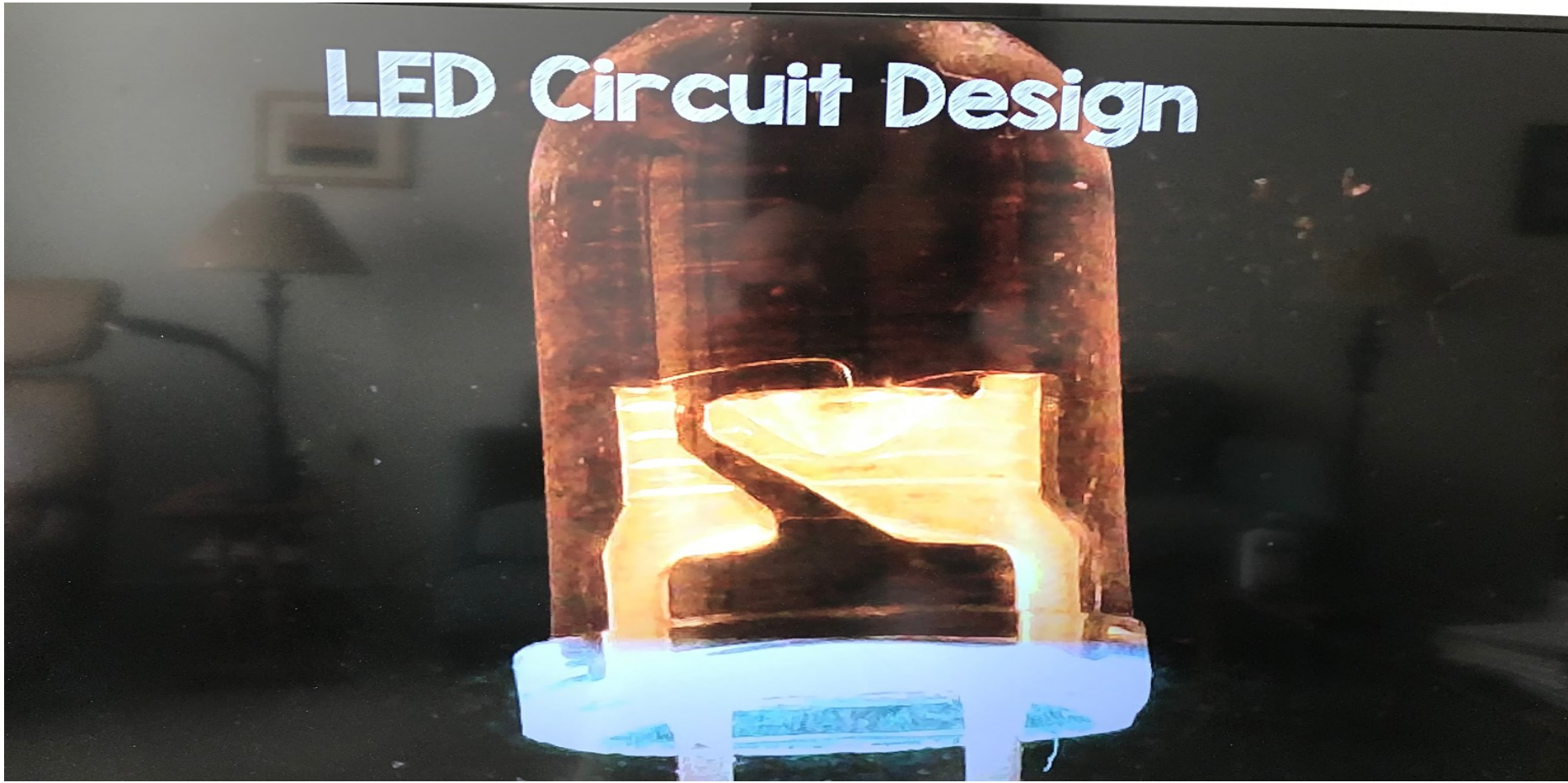
Direct Polarization
Causes Electrons to Flow
With Voltage
Light is Emmited

P N IS OFFSET
TO INCREASE LIGHT

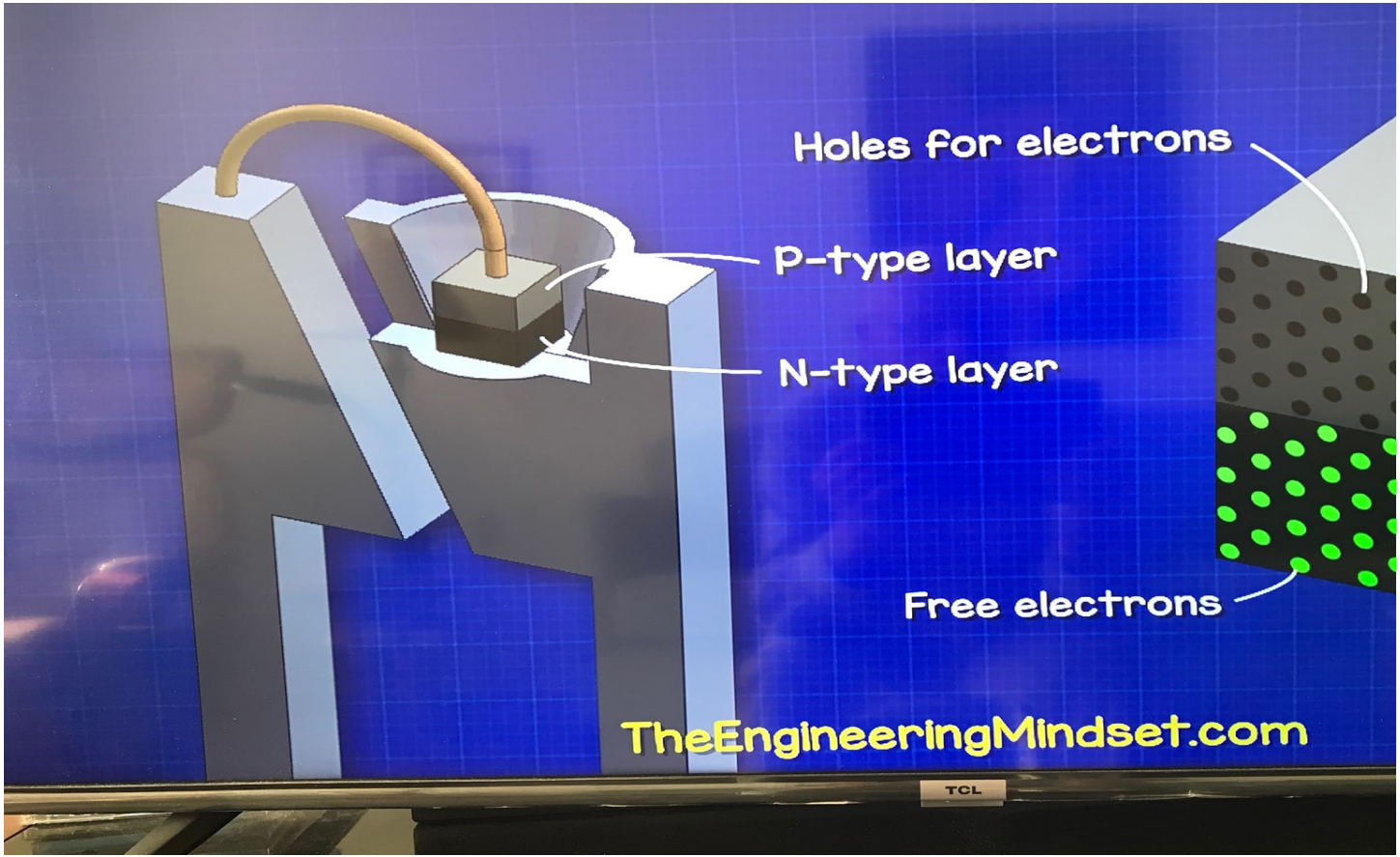

Radio
Infrared
Visible
Ultraviolet
X-Ray
Gamma Ray
100 m
1 m
1 cm
0.01 cm
1000 nm
700 nm
400 nm
10 nm
0.01 nm
0.0001 nm

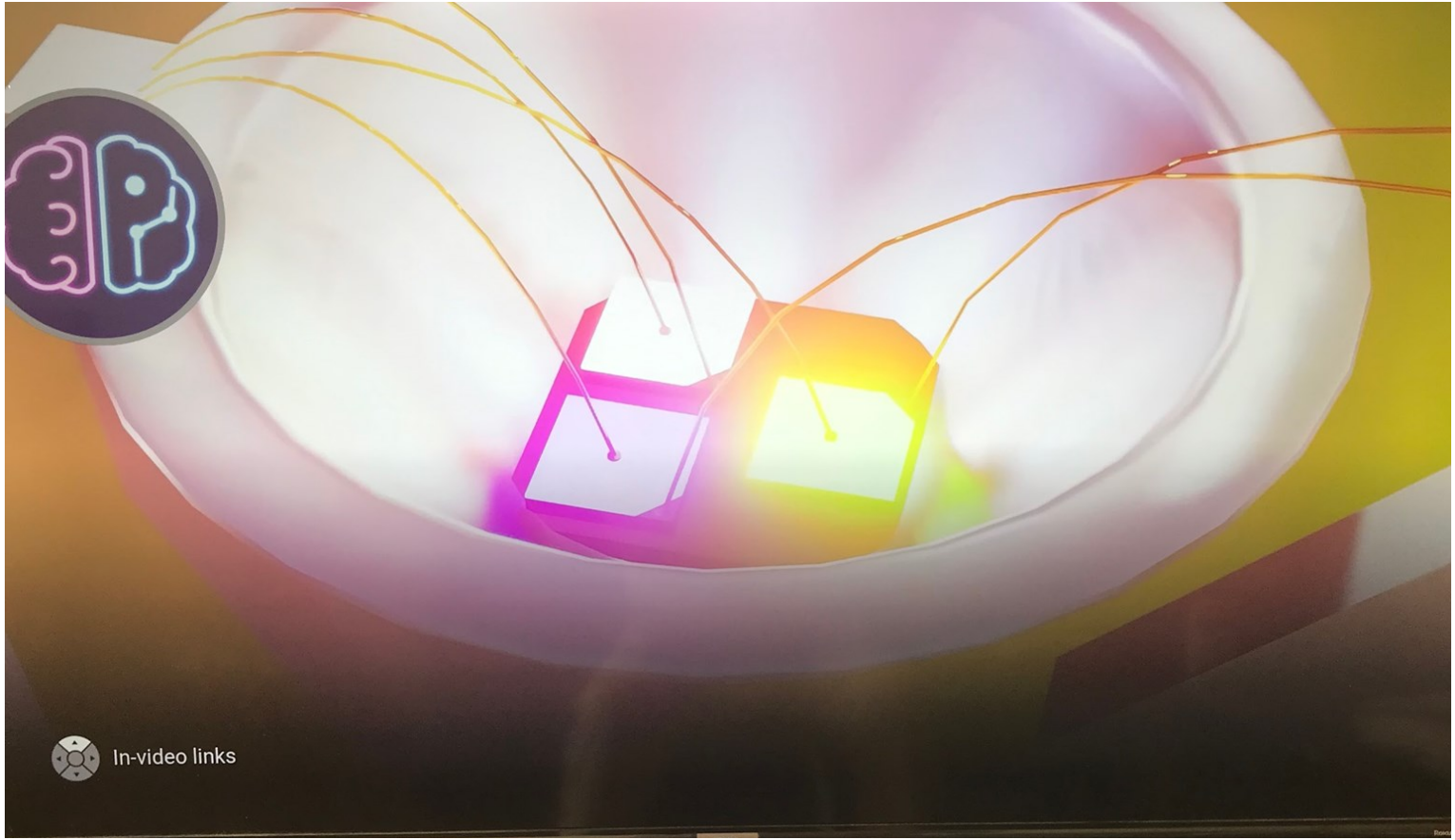


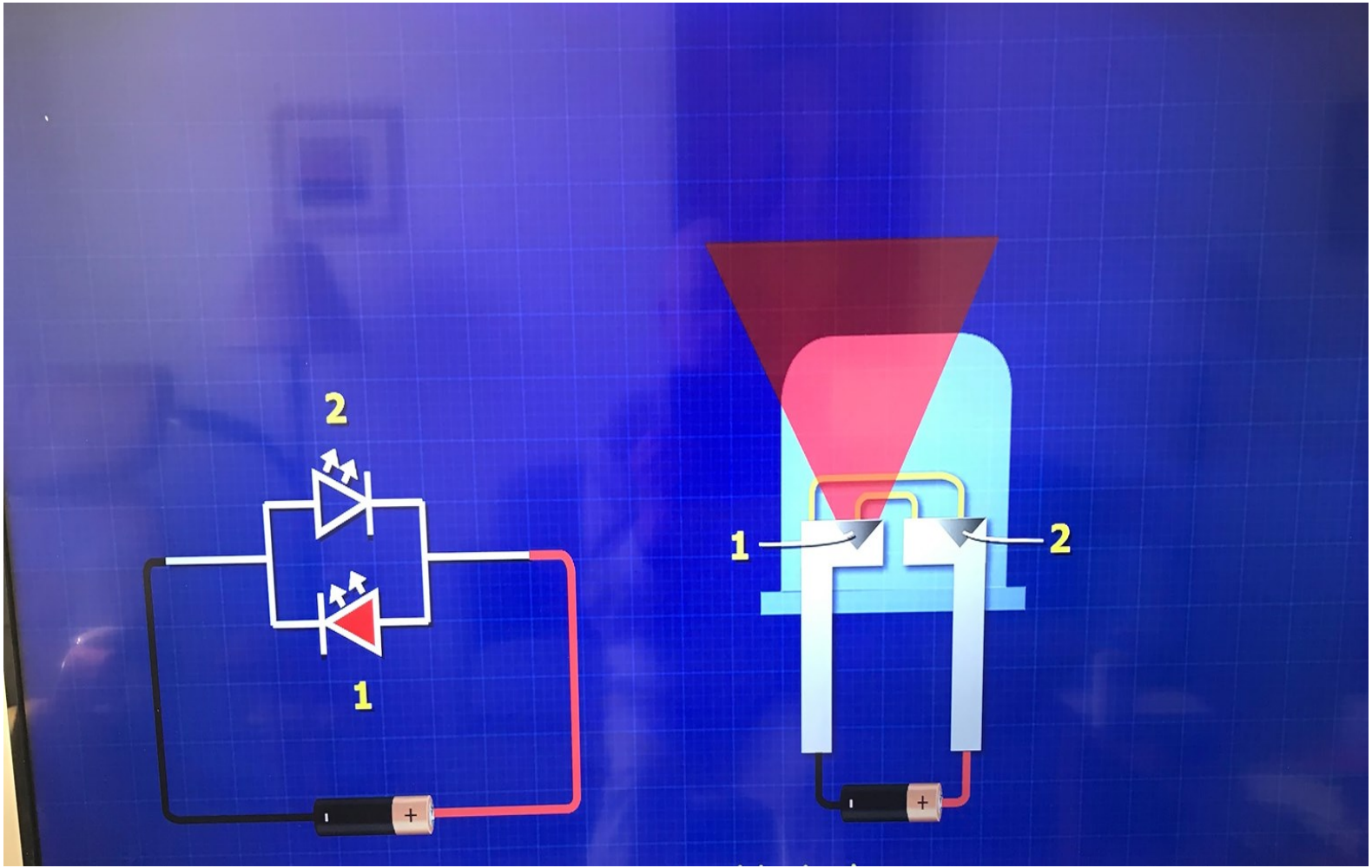

Positive (+)
Anode (A)
Cathode (C)
Negative (-)


LED Circuit Design

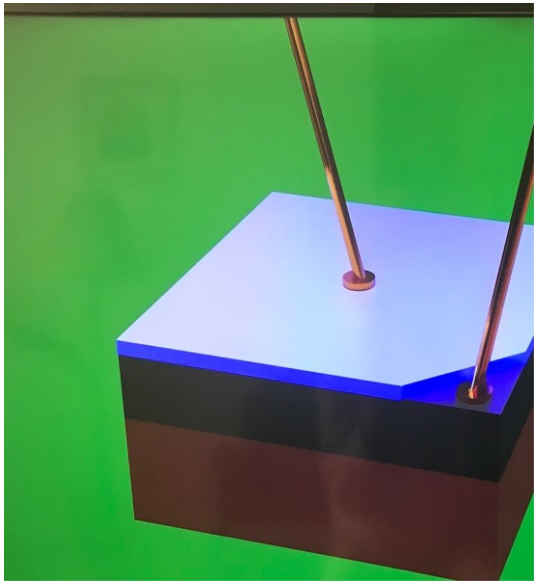
Semiconductor
TheEngineeringMindset.com
TCL


Holes for electrons
P-type layer
N-type layer
Free electrons
TheEngineeringMindset.com
TCL

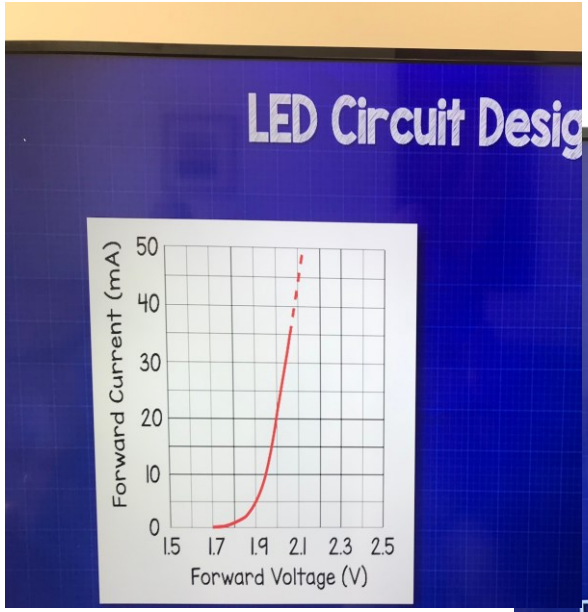

In-video links


2
1
1
2

TCL



LED Light Bulb

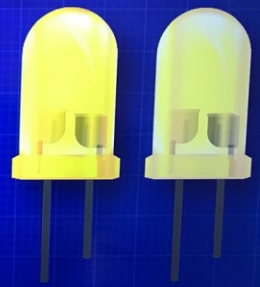


LED Circuit Design

Performance variance is due to:

- Materials used
- Manufacturing process

Try to use LED's from the same batch and from reliable manufacturers



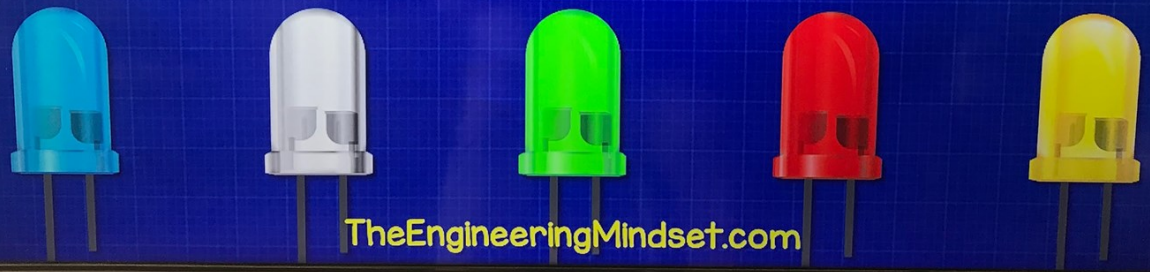
TheEngineeringMindset.com

LED Circuit Design

Color	Forward Voltage @ 20mA
RED	2.0
Orange	2.2
Yellow	2.2
Blue	3.2
Green	3.2

Or use table of typical values

White 3v



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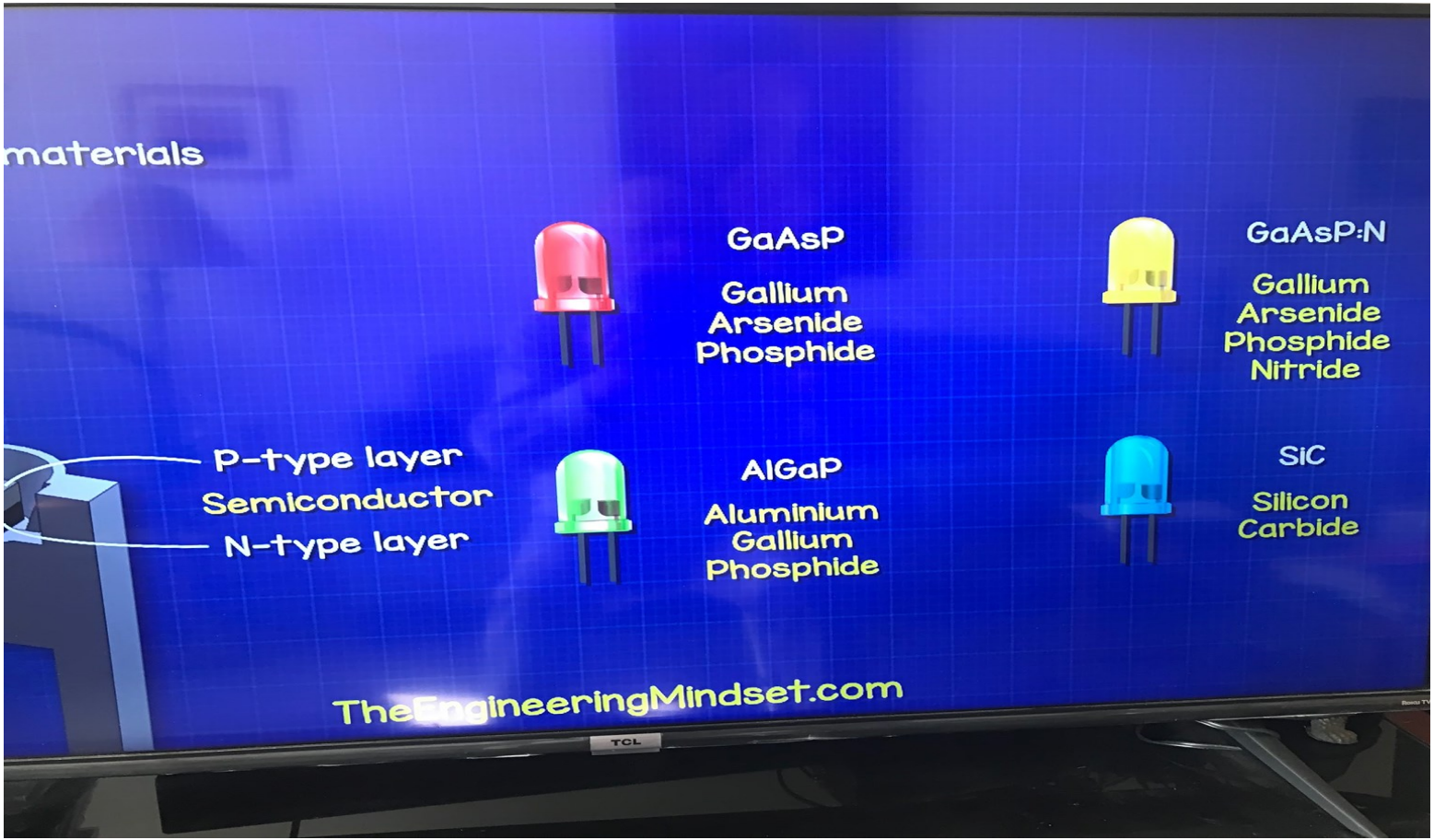

materials
GaAsP
Gallium
Arsenide
Phosphide
GaAsP:N
Gallium
Arsenide
Phosphide
Nitride
P-type layer
Semiconductor
N-type layer
AlGaP
Aluminium
Gallium
Phosphide
SiC
Silicon
Carbide
TheEngineeringMindset.com
TCL

Ohm's Law

How to Calculate LED Resistance

$$V = RI$$

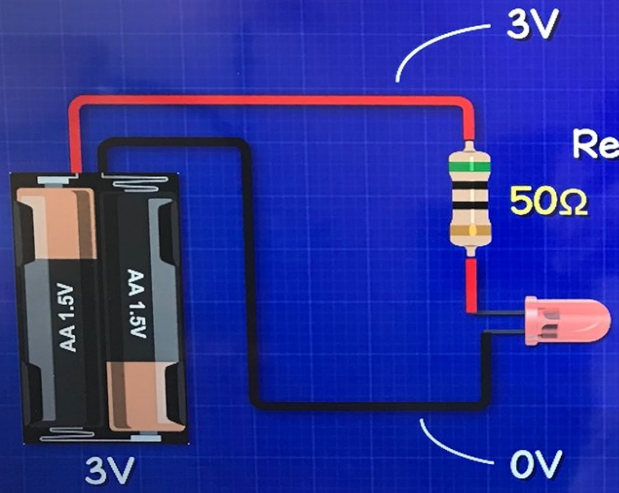
$$R = V/I$$

$$R = \frac{V_{(Supply)} - V_{(LED)}}{I_{(Current)}}$$

(.02 amps)

LED Circuit Design

What size resistor is needed?



Resistor voltage drop = 3V - 2V = 1V

Resistor= 1V ÷ 0.02A = 50Ω

LED Voltage drop = 2V

LED current = 20mA (0.02A)

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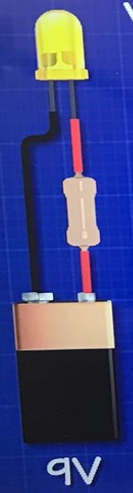
LED Circuit Design



Voltage drop = 2V
Current = 20mA

What size resistor is required?

Resistor voltage drop: 9V - 2V = 7V

The current required is 20mA

Resistor value = 7V ÷ 0.02A = 350Ω

TheEngineeringMindset.com

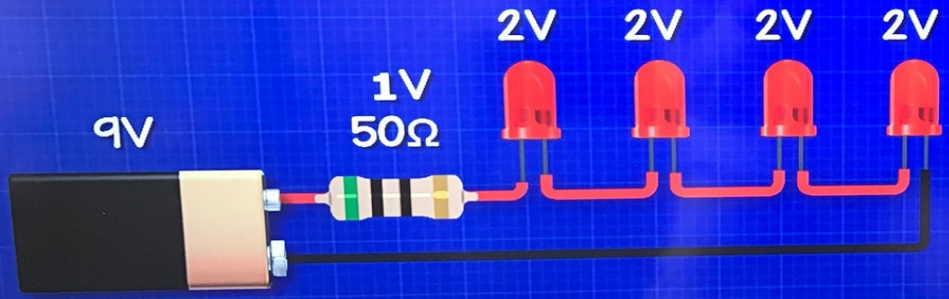
LED Circuit Design

Calculation:

3V - 2V = 1V

1V ÷ 0.02A = 50Ω

3V battery
can only power
1 LED at 20mA

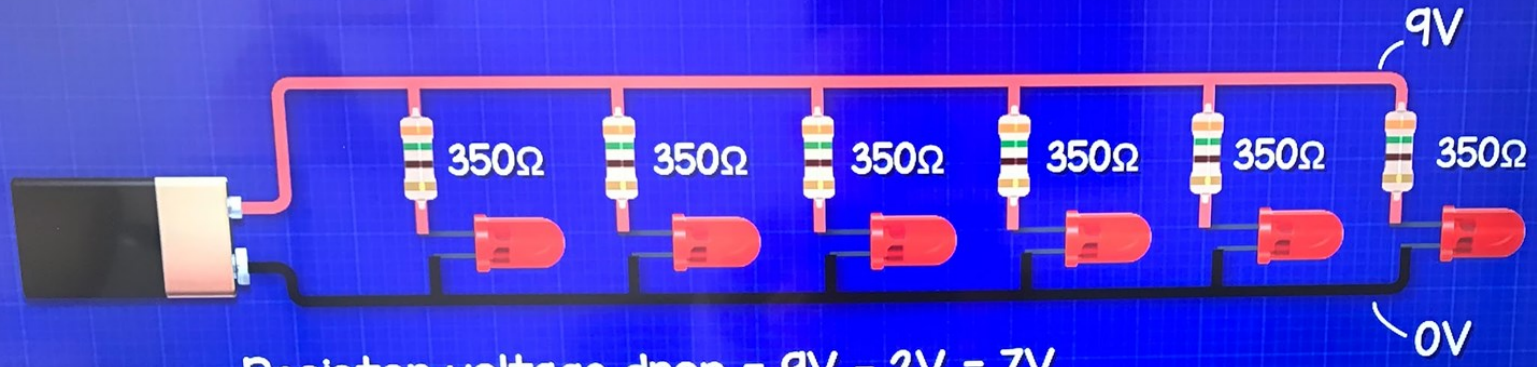


Calculation:

9V - 2V - 2V -2V - 2V = 1V

1V ÷ 0.02A = 50Ω

LED Circuit Design



Resistor voltage drop = 9V - 2V = 7V

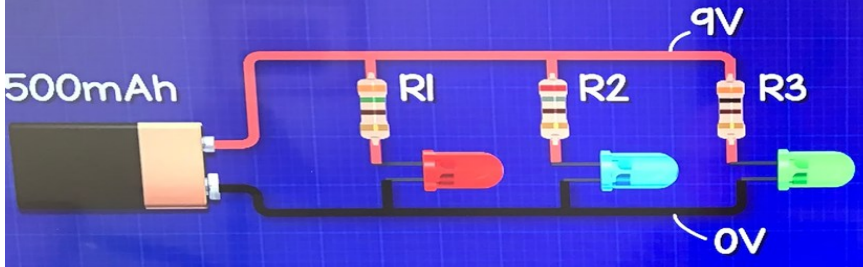
Resistor value = 7V ÷ 0.02A = 350Ω

Resistor power = 0.02^2 X 350Ω = 0.14W

Total current = 0.02A X 6 LED's = 0.12A

Voltage drop 2V, Current required 20mA

LED Circuit Design



Voltage drop

2V

3.4V

3V

Each requires 20mA

Resistor 1

9V - 2V = 7V

7V ÷ 0.02A = 350Ω

Resistor 2

9V - 3.4V = 5.6V

5.6V ÷ 0.02A = 280Ω

Resistor 3

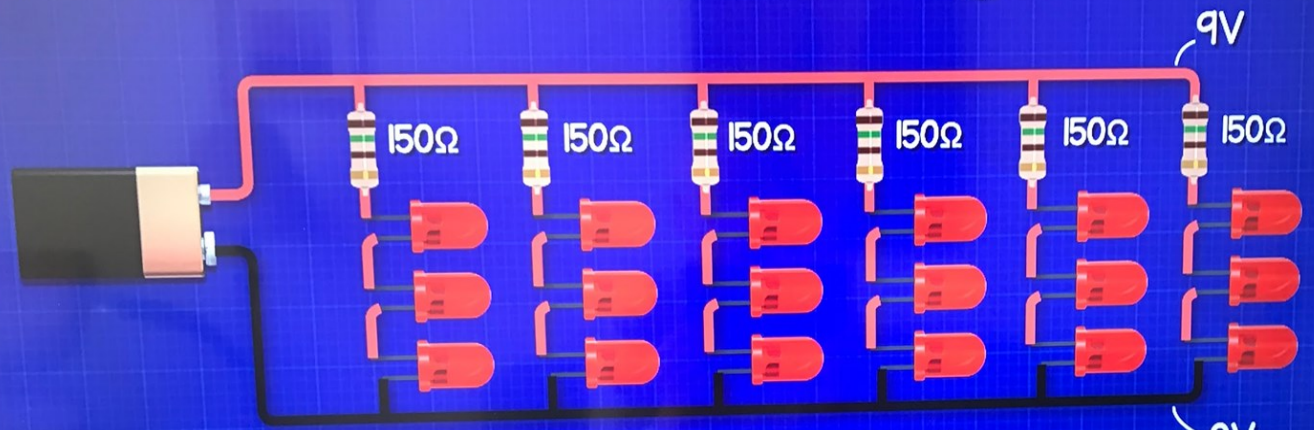
9V - 3V = 6V

6V ÷ 0.02A = 300Ω

Total current = 20mA + 20mA + 20mA = 60mA

Battery life = 500mAh ÷ 60mA = ~8 Hours

LED Circuit Design



Voltage drop per branch = 2V + 2V + 2V =6V

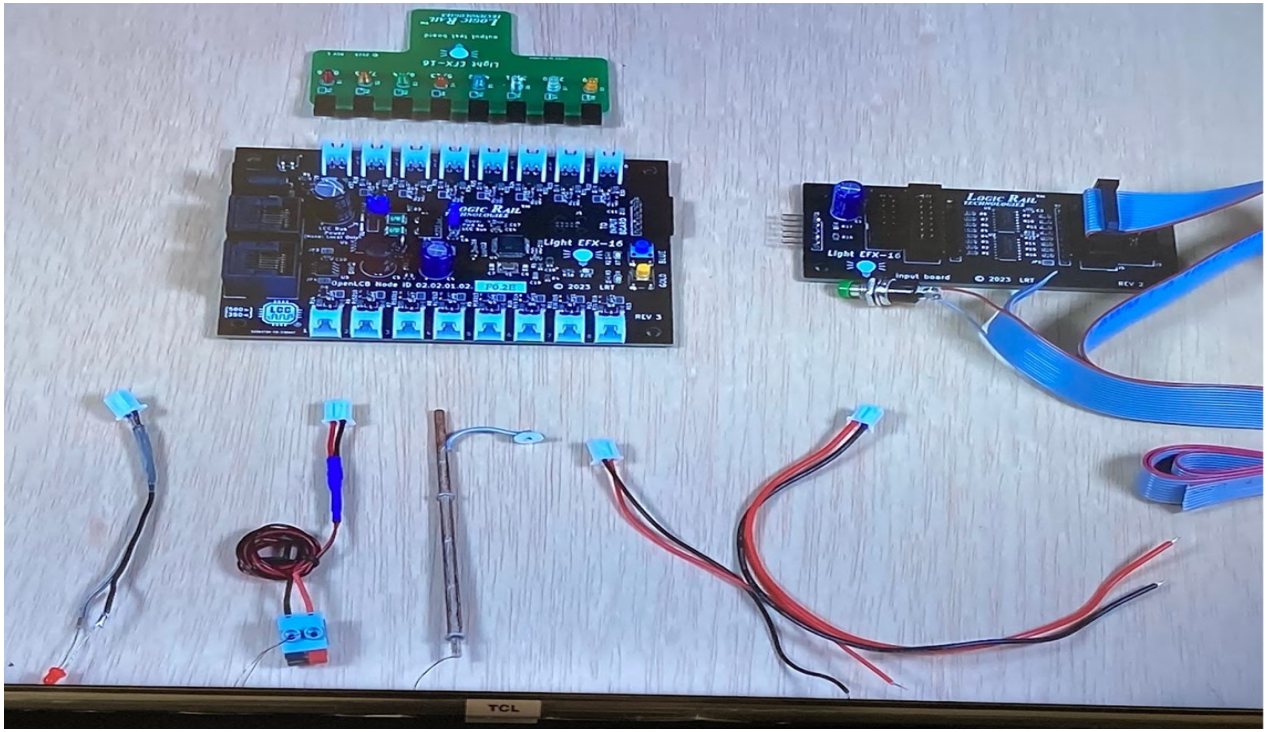
Resistor voltage drop = 9V - 6V = 3V

Resistor value = 3V ÷ 0.02A = 150Ω

Current per branch doesn't increase so we can add more LED's until maximum voltage drop

Voltage drop 2V, Current required 20mA

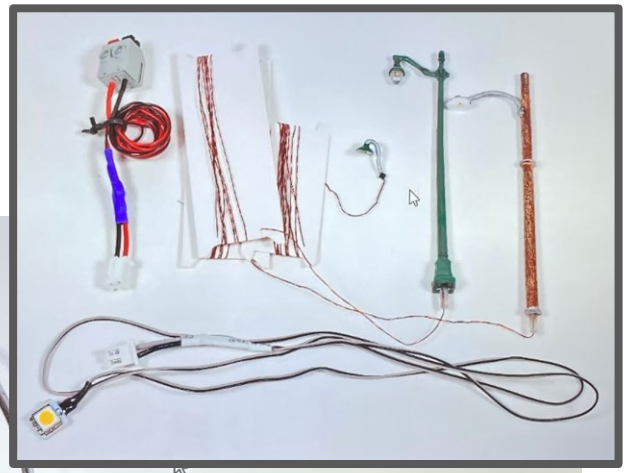
https://evandesigns.com/

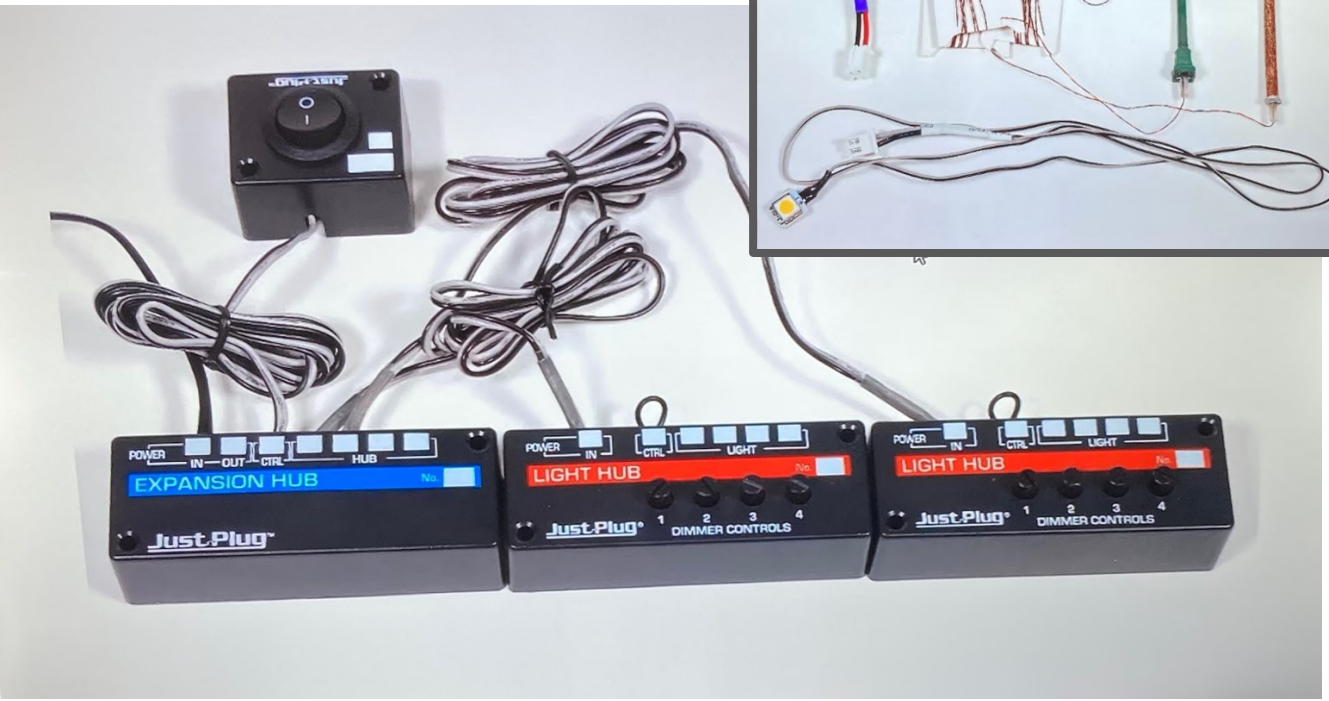


COST $$$$
Com Board - $100
Input Bd - $ 20
Input Cable - $ 6
Output Cable - $. 5

System $200 +
(add light LED cost)

Lighting System - Logic Rail Technologies

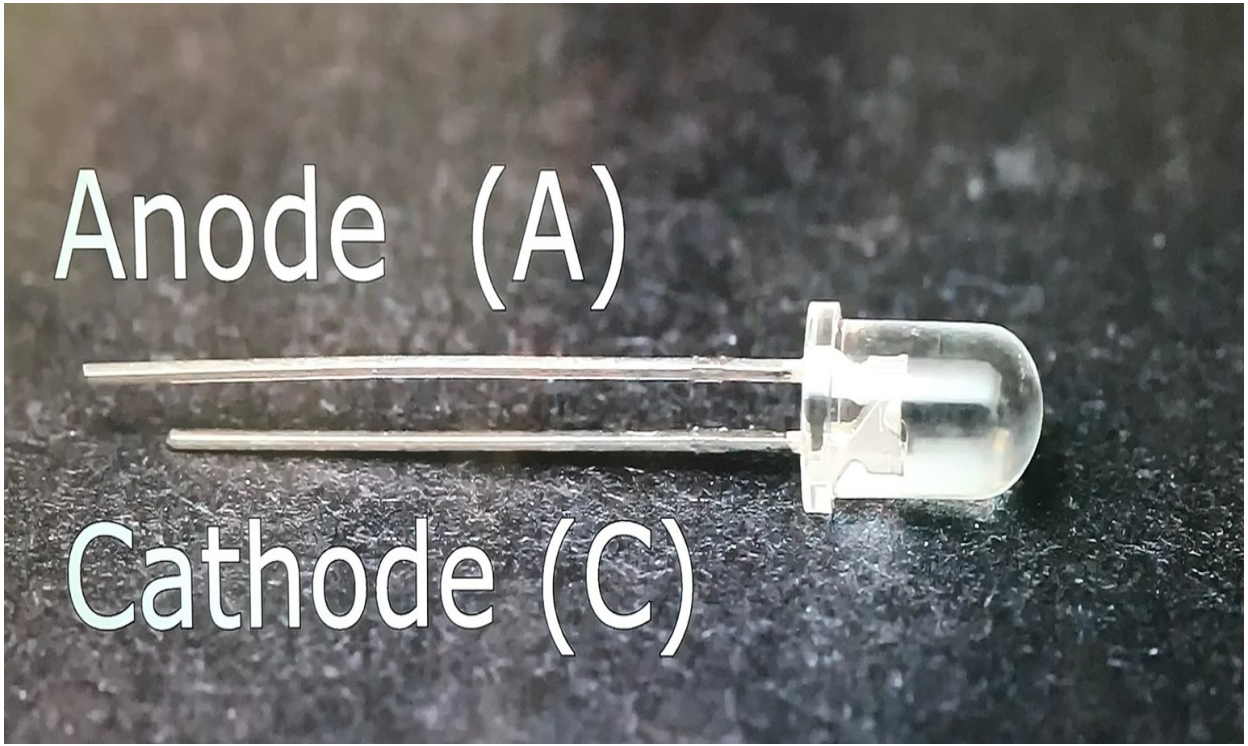




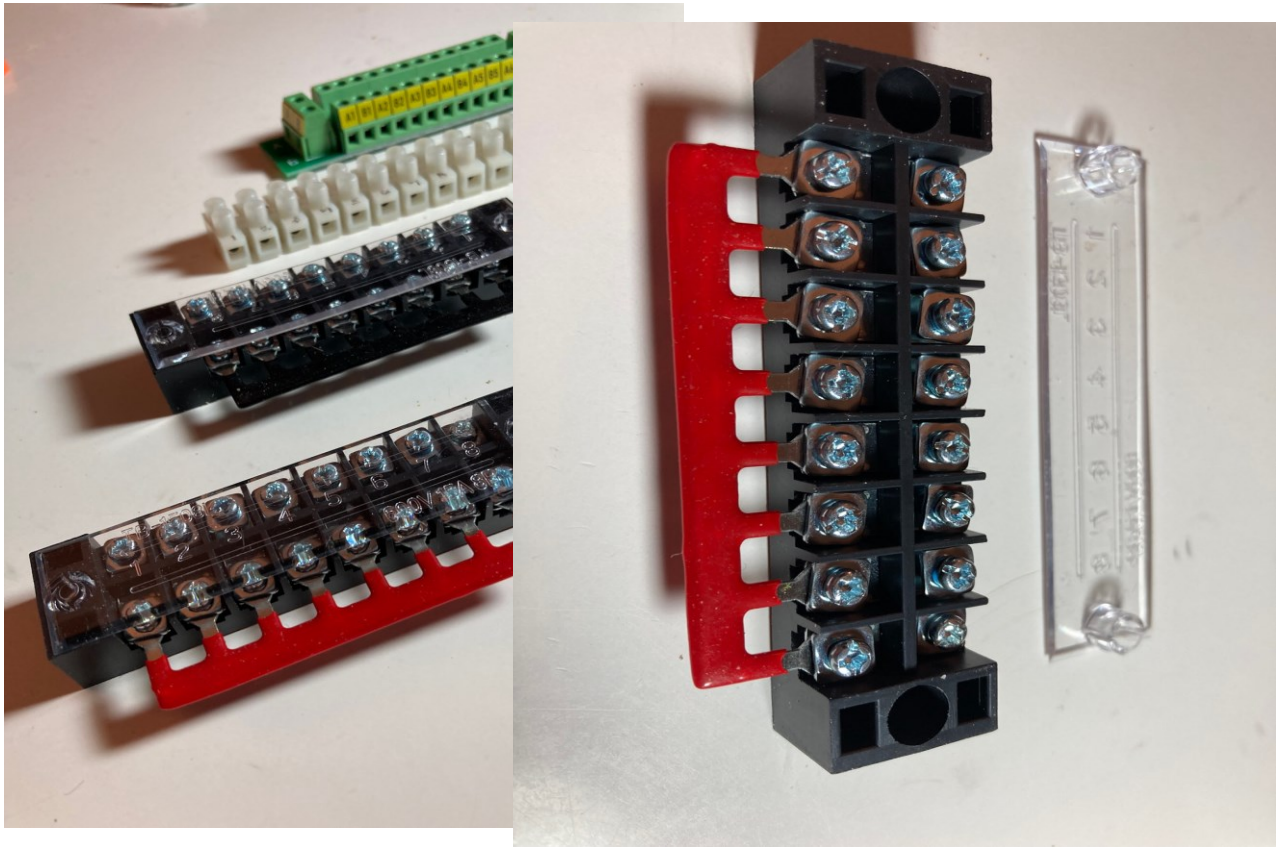
COST $$$
Light Hub - $15
Exp Hub - $14
Pwr Sup - $20
Ext Cables - $ 6
Light Switch - $ 9

System Costs
$100+
(add LED cost)

Lighting System - Woodland Scenics



The short lead is the cathode (-)Black
The long lead is the anode (+) RED
If LED has Flat Side: it is the cathode (-)



Type of wiring connectors used on the NWV layout

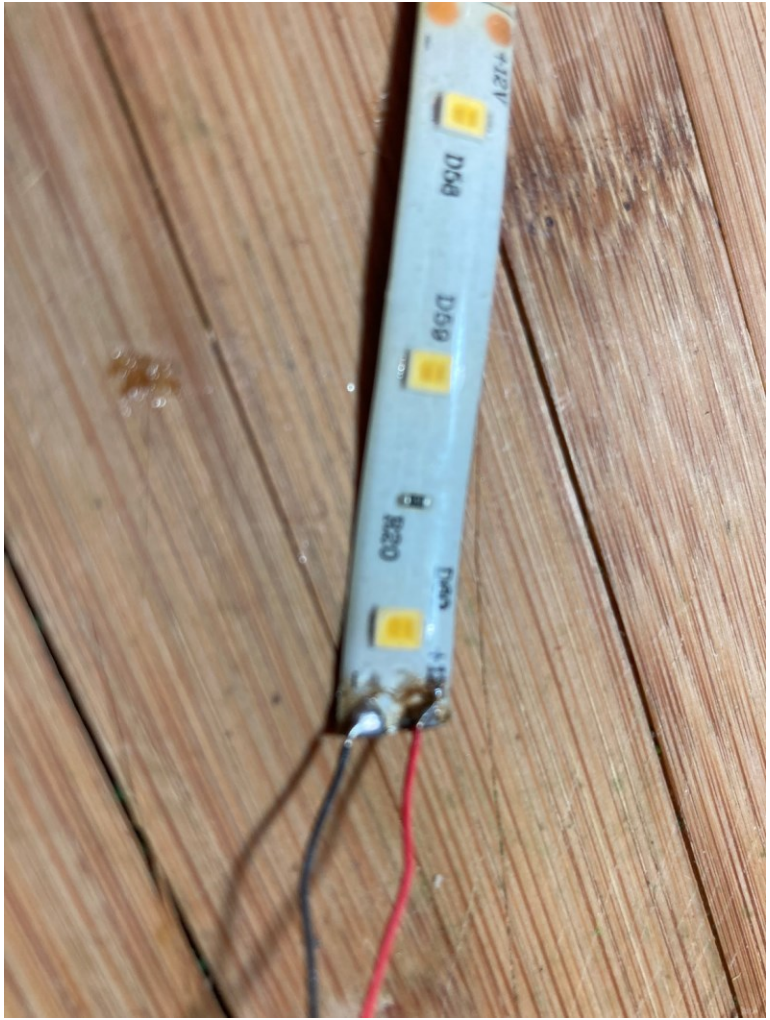
TYPES OF WIRE

Wire Cost

Magnet Wire - $12 (800ft)

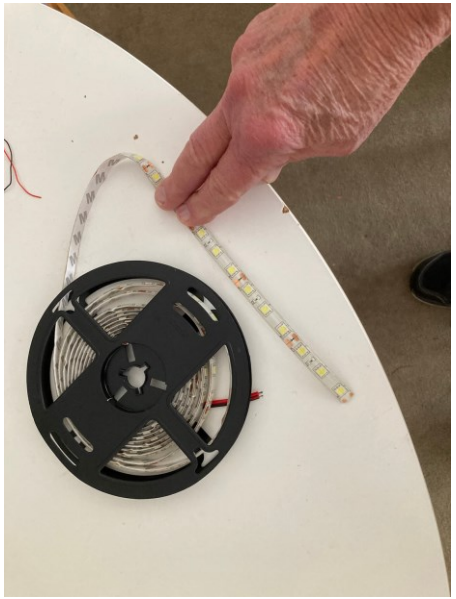
Twisted Wire - $ 8 (30ft)

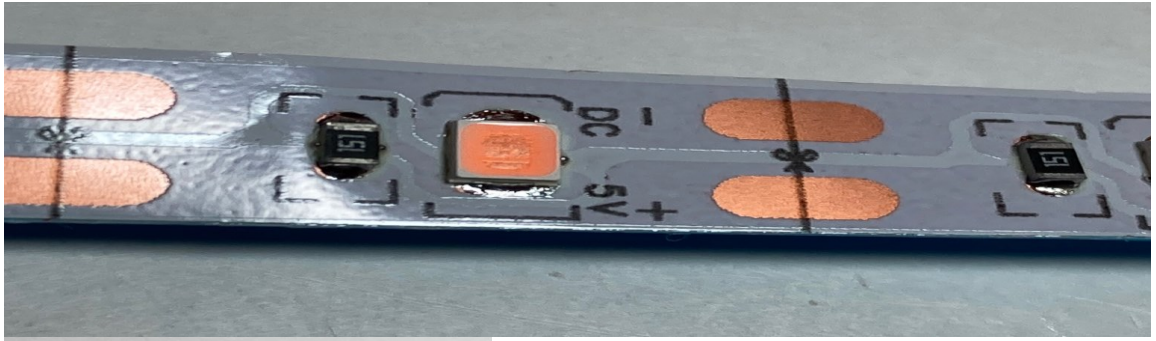
Coiled wire - $10 (50ft)

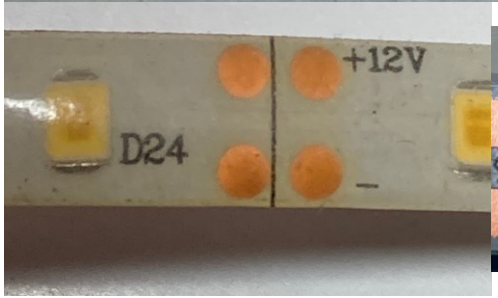


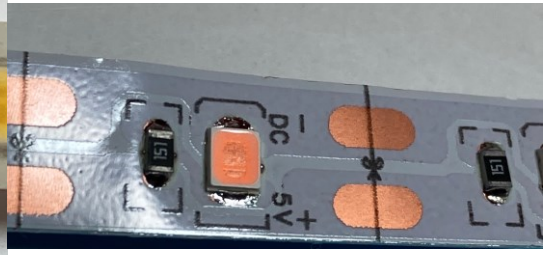
LED Tape Cost

JUNWEN reel - $14.95
Use - 50,000 hrs
Cut - 3 LEDS, 7 LEDS strips/ft, ~142 LEDS/reel
~ $ .11 per LED cut





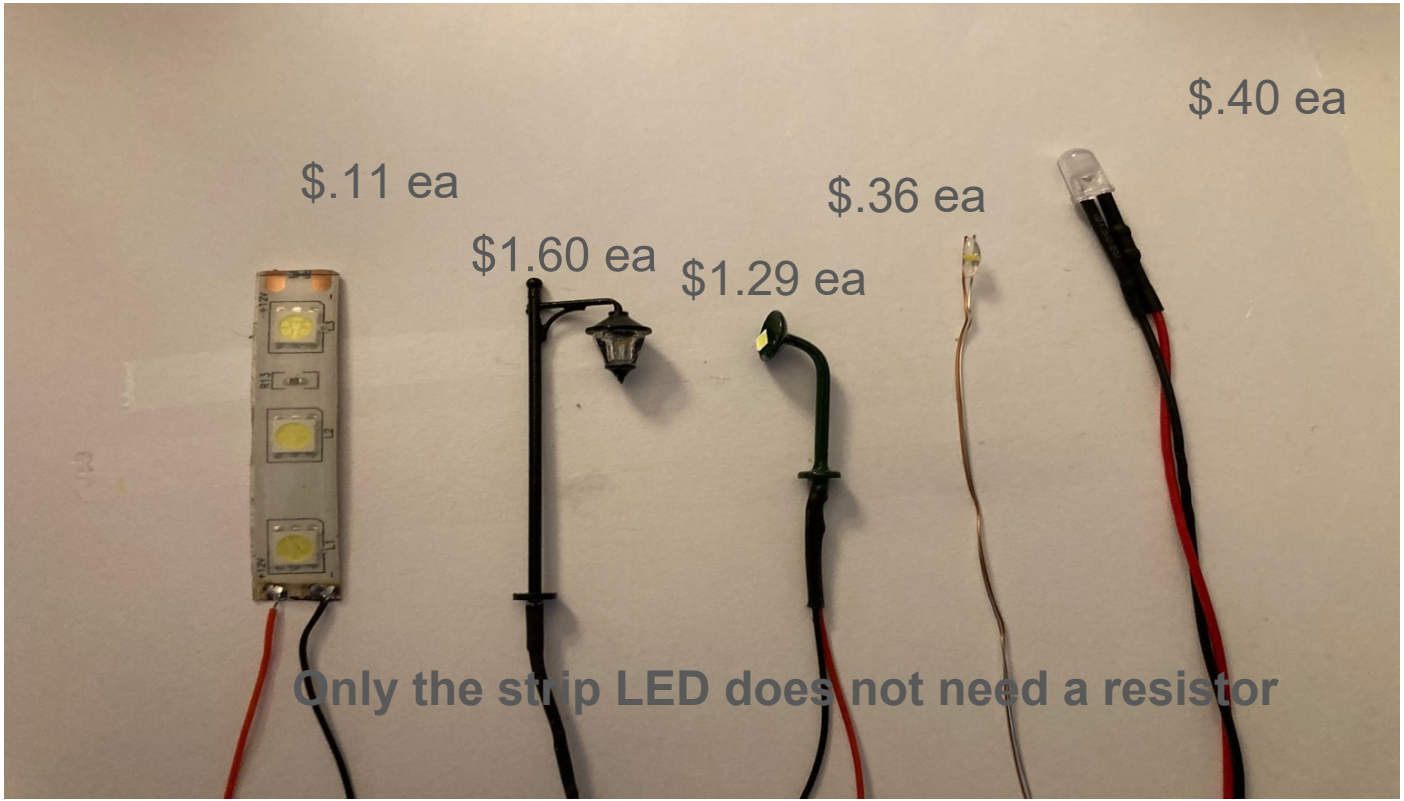


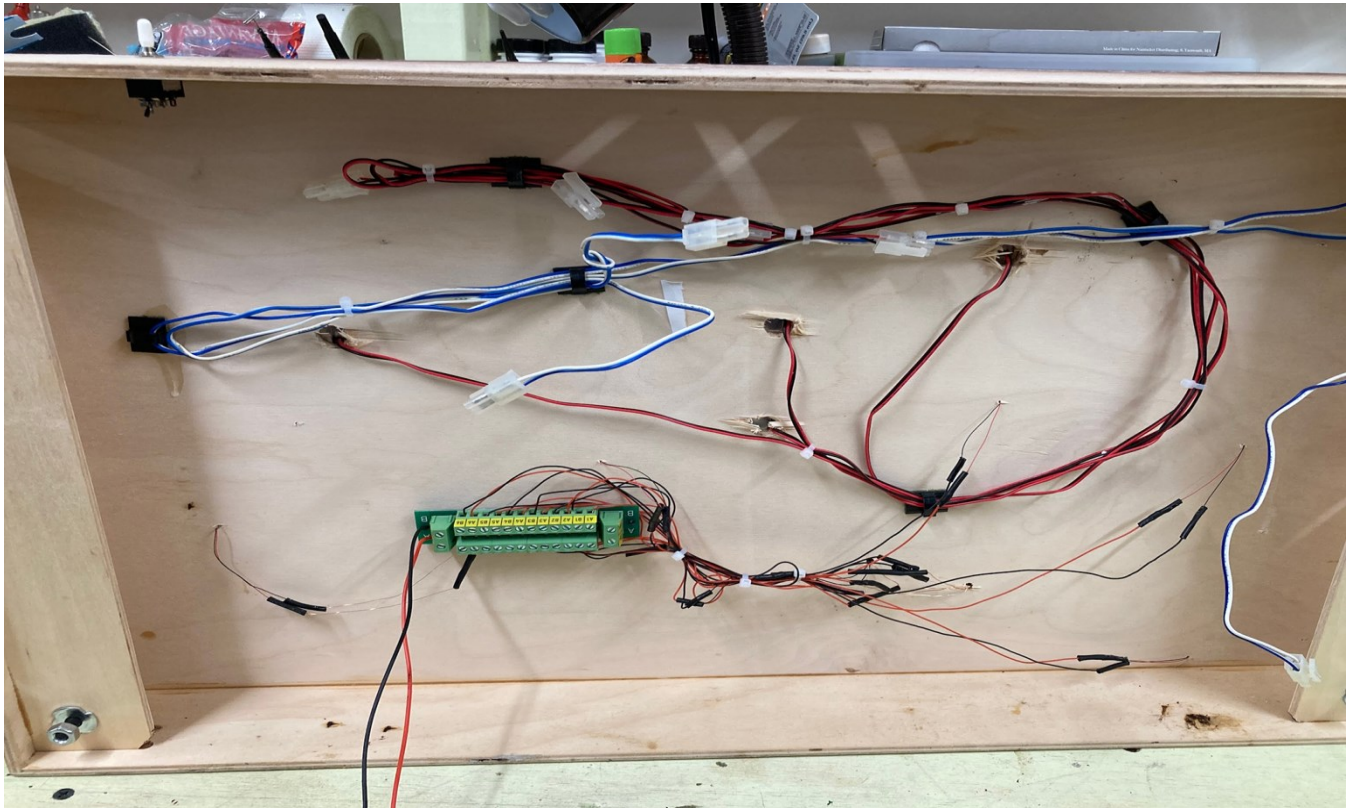


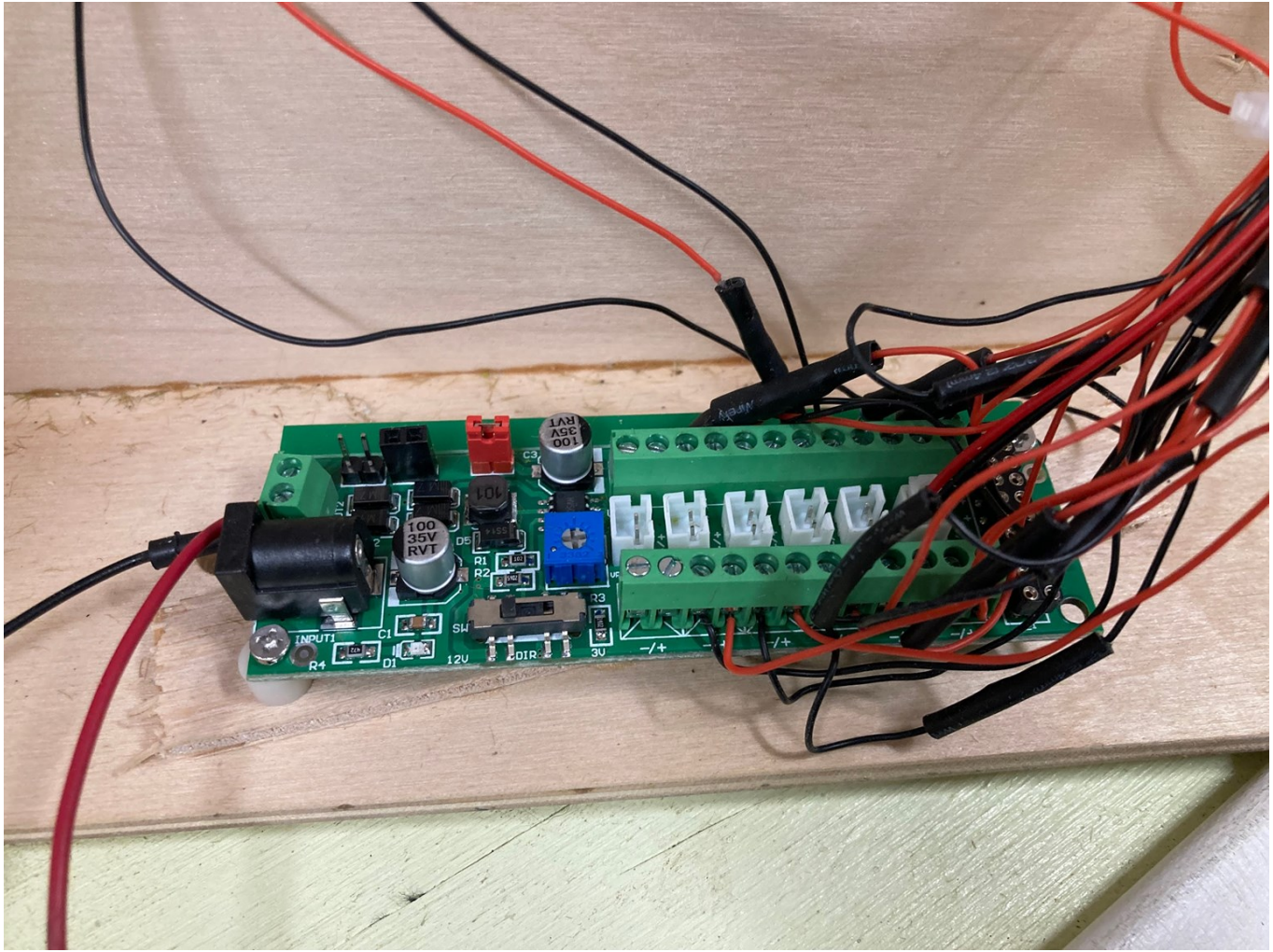
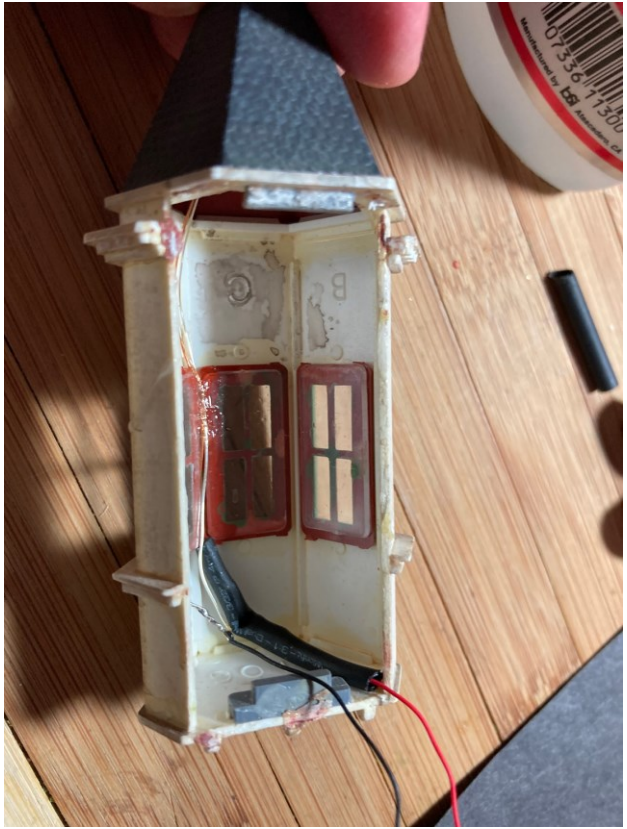
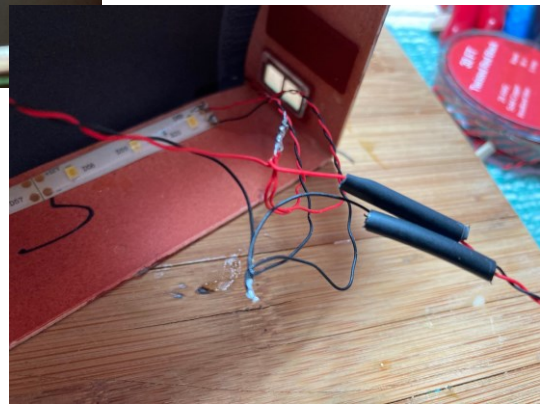
Lighting Strips with SMDs

Note : positive (+) and negative (-) terminals
: required forward voltage (don't exceed)
: attach to models using backing tape plus super glue
: use RED for anode and BLACK for cathode

Typical LED Lights






100
35V
RVT
101
C3
D5
R1
R2
R3
SW
INPUT1
C1
R4
D1
12V
DIR
3V
-/+