# LED AND EL WIRING FOR COSTUMES

# Disclaimer

- I acknowledge inspiration and instruction from various companies, Web sites, forums, and individuals

- **BUT:** I want to make it clear that I am not representing any of those forums, companies, Web sites, or individuals

- Furthermore: None of these organizations have reviewed or approved of the content of this presentation, nor have they reviewed or approved of the costumes I am presenting, or the techniques and materials I will be demonstrating

# Disclaimer (part 2)

- The construction techniques and finished products have not been reviewed for quality, integrity, or suitability by any of the organizations named

# Disclaimed Parties

- The Hunter's Lair
- SparkFun Electronics
- Toho Company Ltd.
- Daiei Film
- 20<sup>th</sup> Century Fox
- Stan Winston Studios

- MarsCon
- The D.O.O.M. Squad
- CONvergence Events Inc.
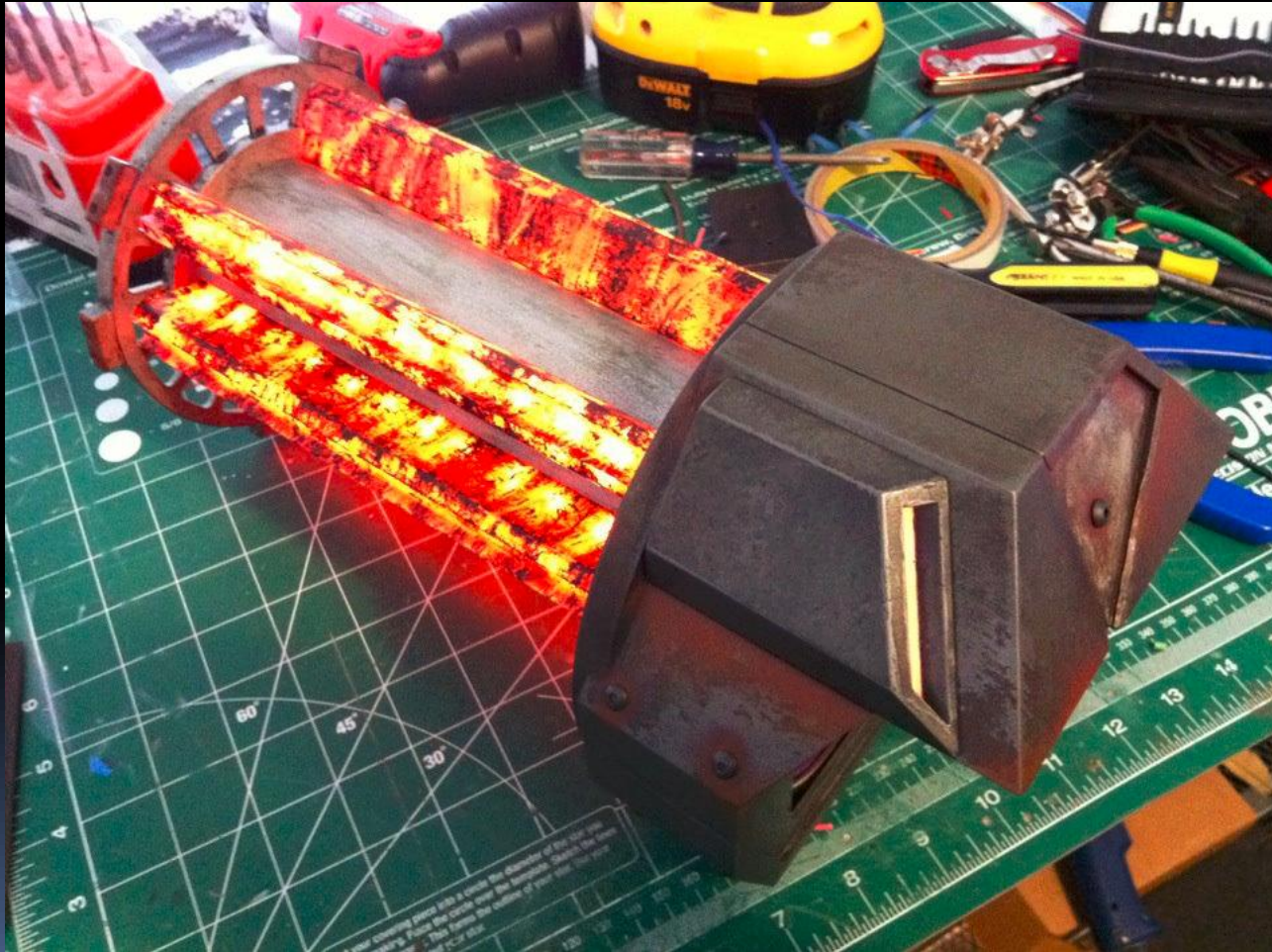- Dragon*Con
- Ladyada.net
- Adafruit.com

# Why I need a disclaimer

- "Stevie Wonder going passed on horseback, should be able to see that someone wearing a forums apparel looks like they are a official representative of that forum.
Which to be honest is alittle daft/cheaky unless asked to do so. "

# Why do you want your costume to light up?

- Because it's cool.

# Volpin Props

# First Avenue Halloween 2011

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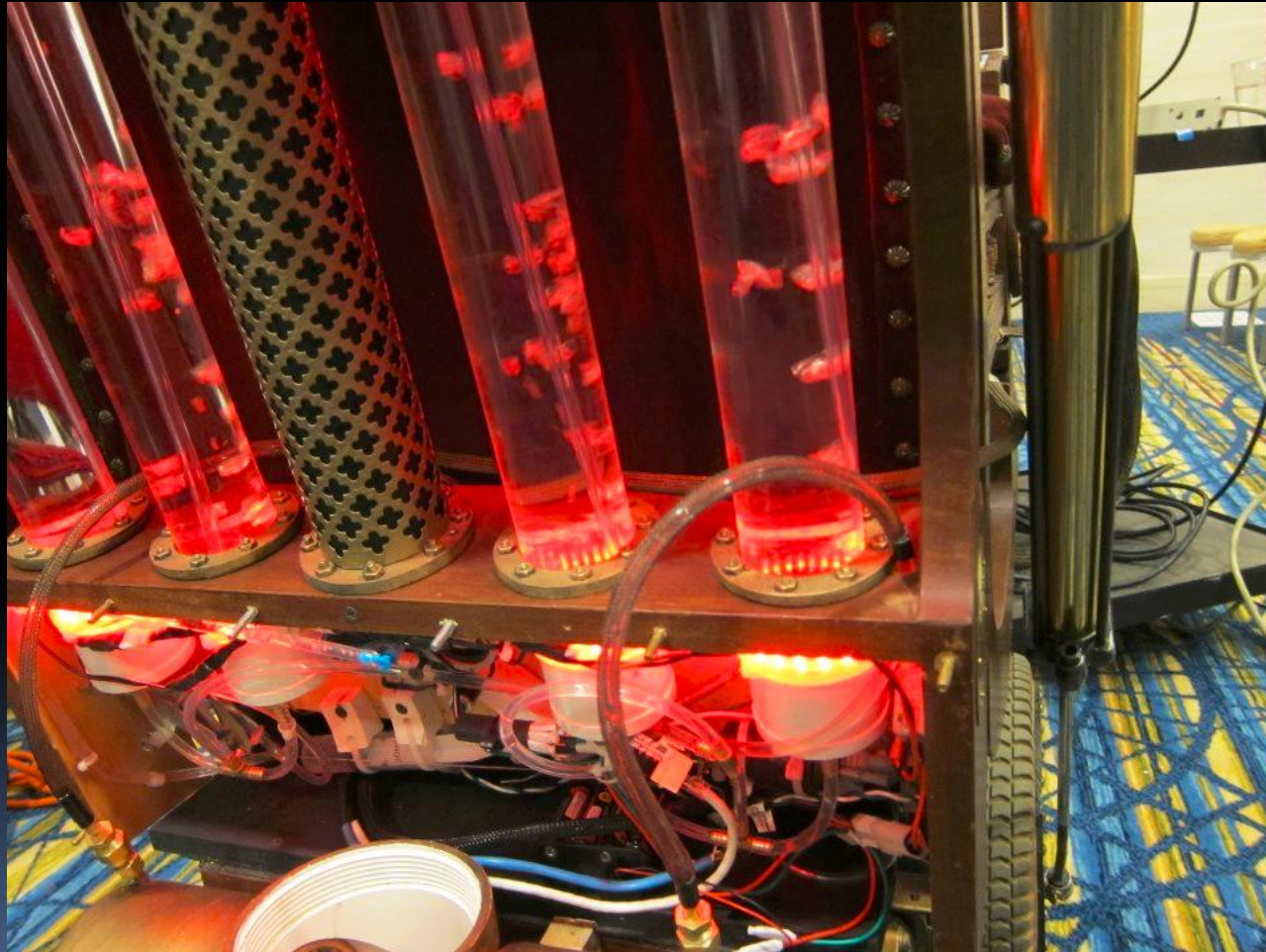# First Avenue Halloween 2011

# Dragon*Con 2011

# Dragon*Con 2011

# Dragon*Con 2011

# Black Dragon with EL wire and LEDs

# LEDs: The basics

- Light Emitting Diode: Current flows in only one direction
- The positive lead (also called the anode) is marked with a + sign, or has a longer leg
- The negative lead is called the cathode
- Tutorial: http://www.ladyada.net/learn/arduino/LEDs.html

# LEDs: A Rainbow of Colors

# Do I need a special power source?

- In most cases, regular batteries should work fine
- I've used a rechargeable 12 volt battery for some projects that use a lot of LEDs
- Either two AA batteries in a holder, or a 9 volt battery with a clip, are sufficient
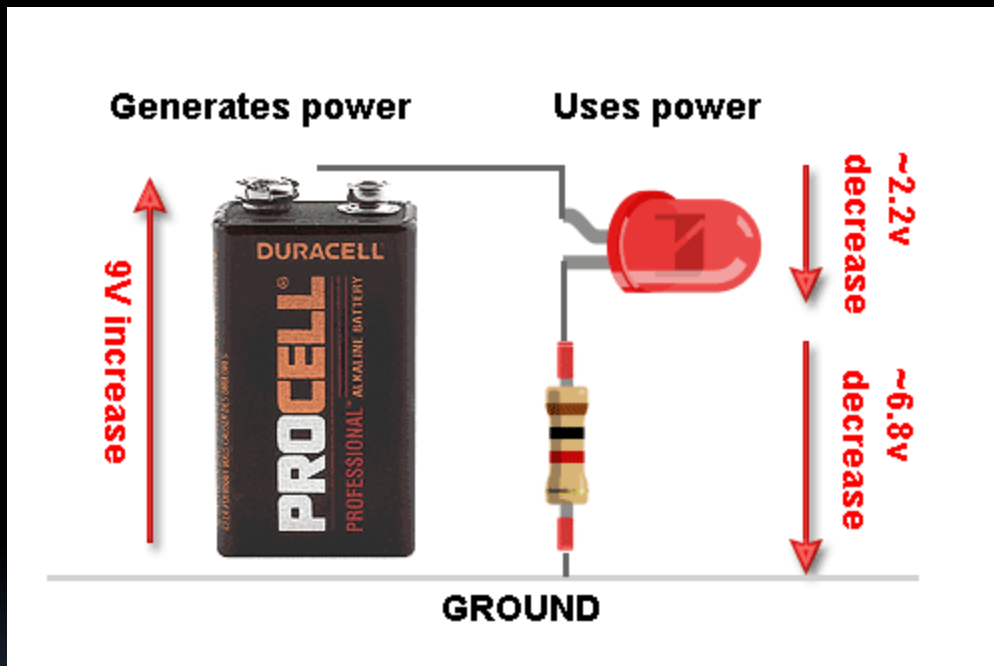- Don't worry, the batteries don't get hot

# Resistance is Not Futile, It's Actually a Good Idea

- You can control the brightness of an LED with a resistor

- Putting too much current through an LED will destroy it, so connecting them directly to a big battery isn't a good idea

  - The small button batteries found in flashlights don't seem to put out excessive current

# Whoa, Electronics Terminology

- Every LED has something called a "forward voltage drop": the LED uses some amount of voltage within the circuit

- The resistor is there to use the rest of the power in the circuit

# This is what voltage looks like



Generates power — Uses power

9V increase

~2.2v decrease

~6.8v decrease

DURACELL PROCELL PROFESSIONAL ALKALINE BATTERY

GROUND

•Red, orange, yellow, and some basic green LEDs have a forward voltage of 2.0 to 2.4 volts
•White, blue, and violet LEDs use more forward voltage: usually 3.0 to 3.4 volts
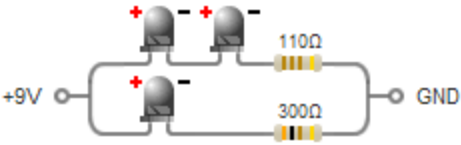•When you buy LEDs, the package will have a data sheet explaining what the forward voltage drop is

Diagram stolen from the ladyada.net LED tutorial

# Making it easy

- There are Web sites that will calculate what resistors you need in a circuit
  - You'll need to know the LED forward voltage drop and the LED current rating from the LED data sheet
  - You also tell the calculator what power you're putting in and how many LEDs you're using
- http://ledcalculator.net

# Example: Three blue LEDs with a 9 volt battery

This LED calculator will help you design your LED array and choose the best current limiting resistors values. To get started, input the required fields below and hit the "Design Circuit" button.



- You will need 1 x 110 ohm 1/8 watt and 1 x 300 ohm 1/8 watt resistors.

- The 110 ohm resistor is color coded: Brown, Brown, Brown, Gold.

- The 300 ohm resistor is color coded: Orange, Black, Brown, Gold.

- ...

- The resistor values are calculated based on the common ±5% tolerance resistors.

- Make sure to wire the LEDs in the correct direction as shown below.

- Always leave some space for the resistors to breathe. They might get hot.

# Sewable LEDs
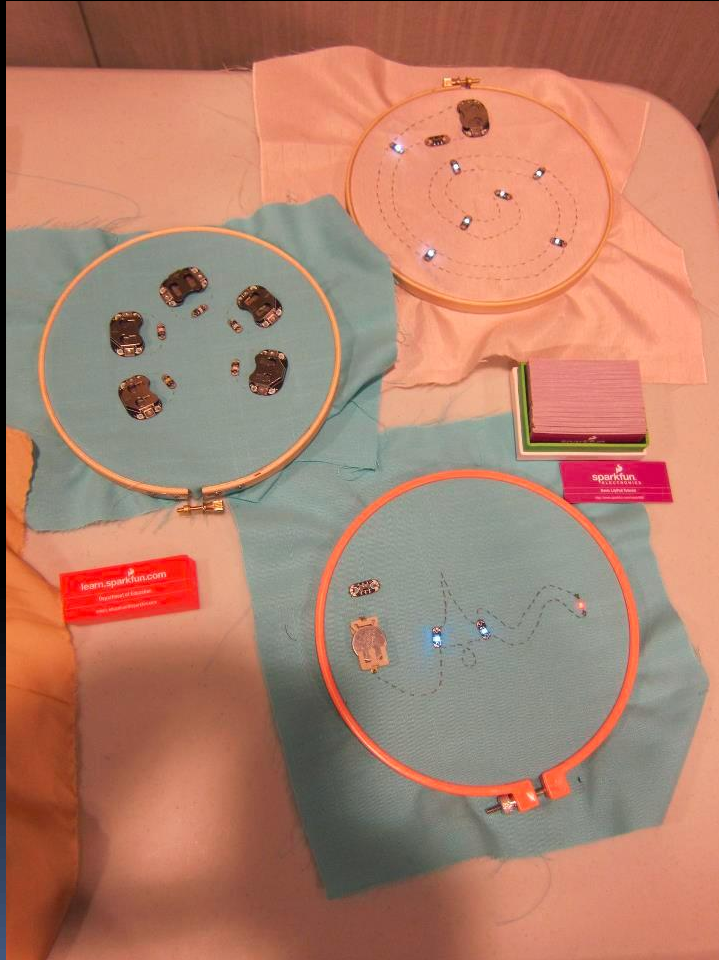


Sewn right into garments with conductive thread
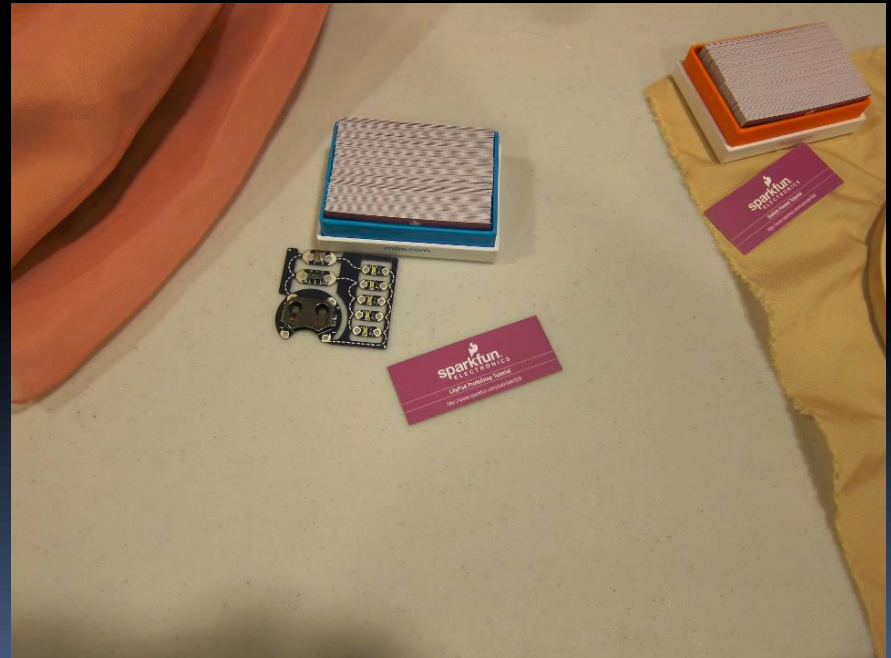
# Sewable LEDs



Shown in this kit:
- Arduino LilyPad controller
- Lithium polymer battery
- Buzzer
- Small vibrating motor
- Light sensor
- Temperature sensor
- Red/green/blue LED
- Slide (off/on) switch
- Pushbutton switch
- USB programming port connector
- Conductive thread
- Needles
- 5 white LEDs

# Programming lights to blink

- The Arduino LilyPad is a module with a programmable microprocessor that connects to your computer

- Programming is done in a language like C++

- Explaining how to program it would probably take too long for this demo…
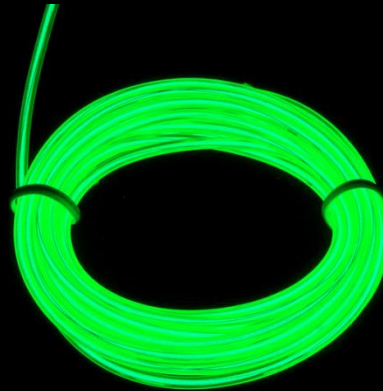
# Electroluminescent (EL) wire

- Available in various colors
- Driven by a battery pack through an inverter
  - The inverter converts 3 or 12 volts into 110 volts AC
  - I wouldn't try to plug EL wire into your AC power line…
- Different inverters drive different lengths of wire
  - 3-volt inverter drives 3 meters of wire
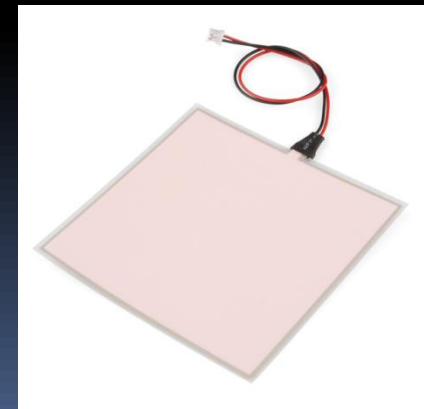  - 12-volt inverter drives 10-15 meters of wire

# A Rainbow of Colors



Also available in tape and panels

# Sewing EL wire

- http://www.instructables.com/id/how-to-add-EL-wire-to-a-coat-or-other-garment/



- Can loop thread around the EL wire, then sew the thread into a garment
- This example uses monofilament fishing line

# A few tips

- EL wire is stiffer than most fabrics, so sewing it onto lightweight or stretch fabrics will dominate the drape of the garment

- Leather, suede, denim, thick polyester/cotton blends would work

- Don't plan sharp bends in the wire – the center core is solid copper, and can break if flexed too much

- Plan to hide the unlit wire connectors, inverter, batteries, etc. inside your garment