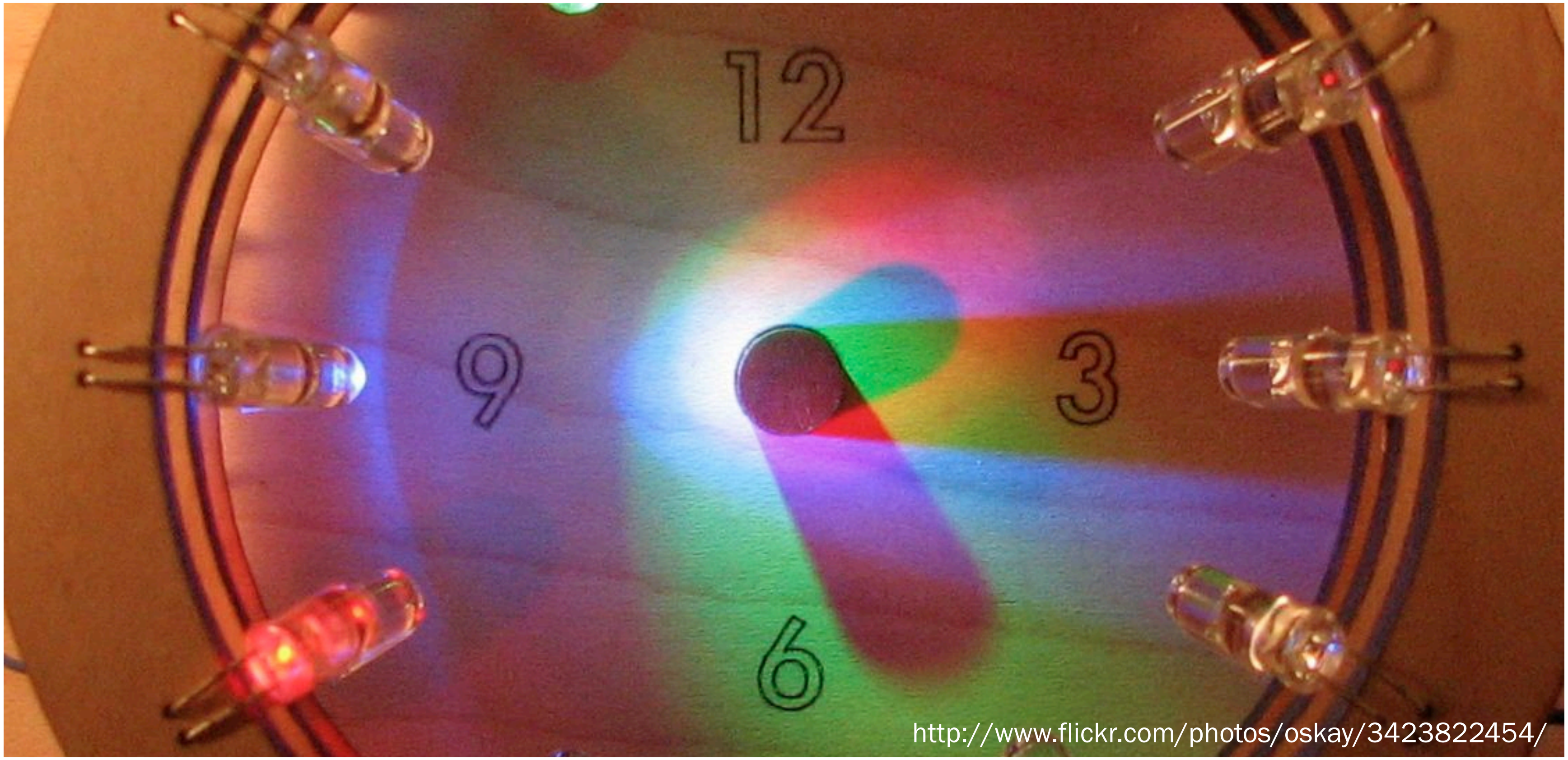
Intro to Electronics

Week 1

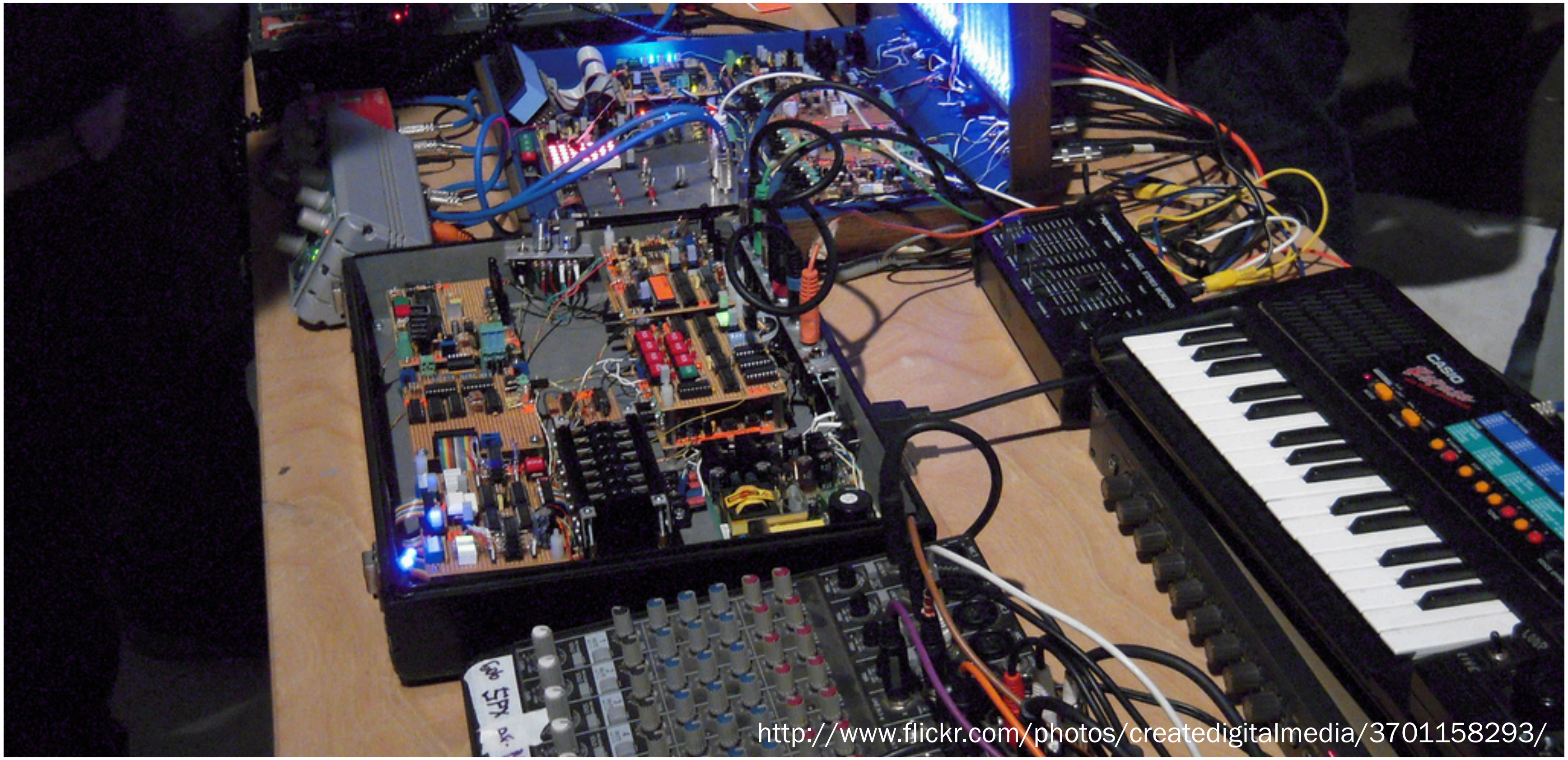
What is included?

DIY ELECTRONICS

Lights

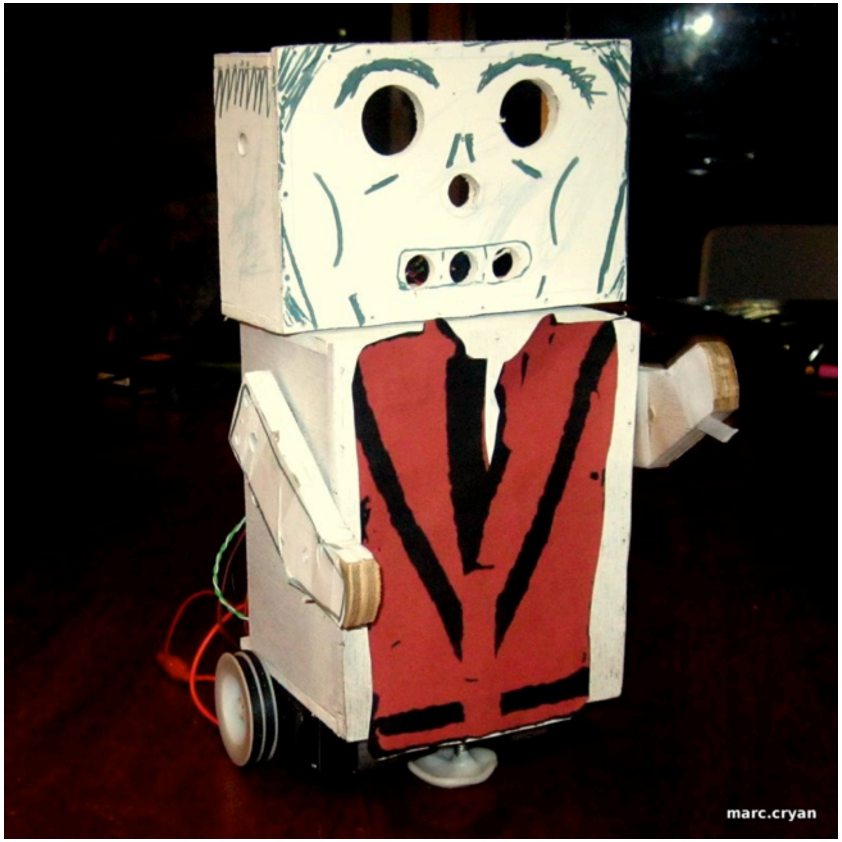


Sounds



http://www.flickr.com/photos/createdigitalmedia/3701158293/

Robots



http://www.instructables.com/id/Wendell-the-Robot/

Whatever else you come up with

How does this work?

THE CLASS

Six weeks, one night per week

- Walk through building a new project each session
  - Light stuff, count stuff, provide power to stuff…
- Learn about different parts and how to use them

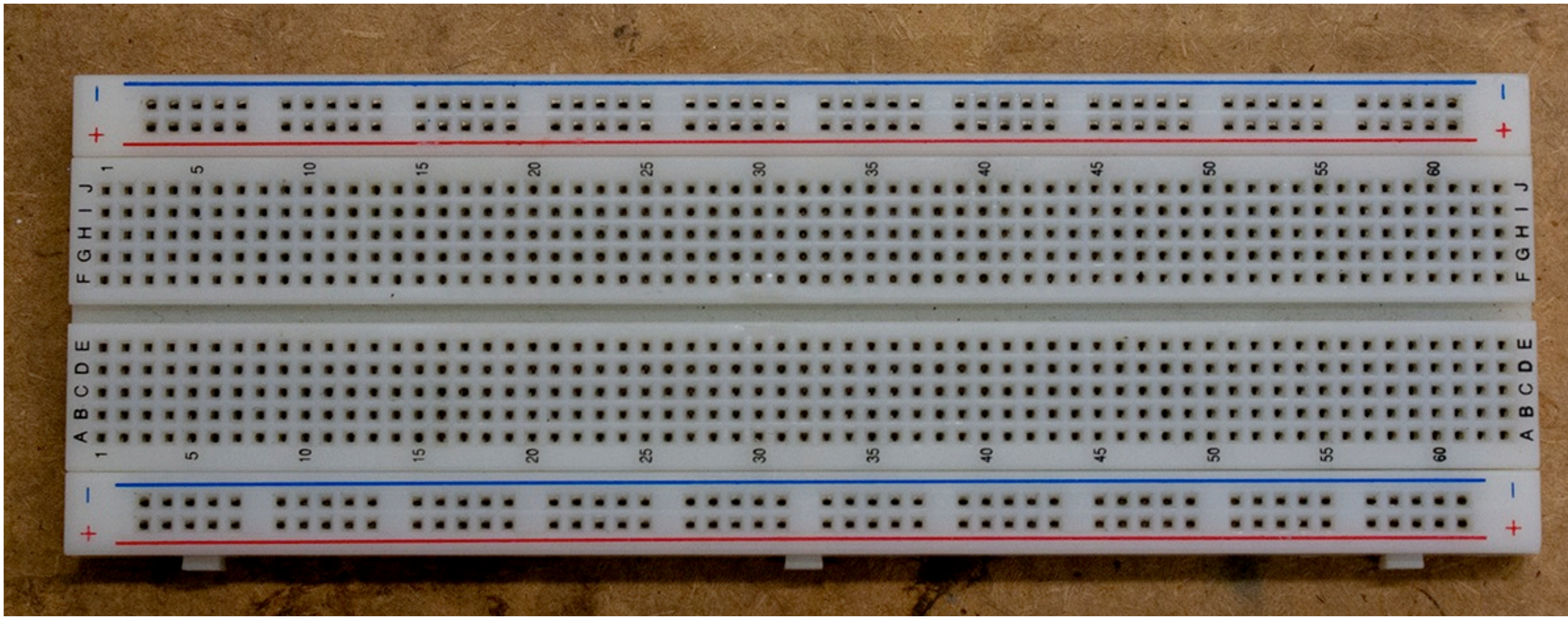
Light up an LED with batteries and a switch

TODAY'S PROJECT

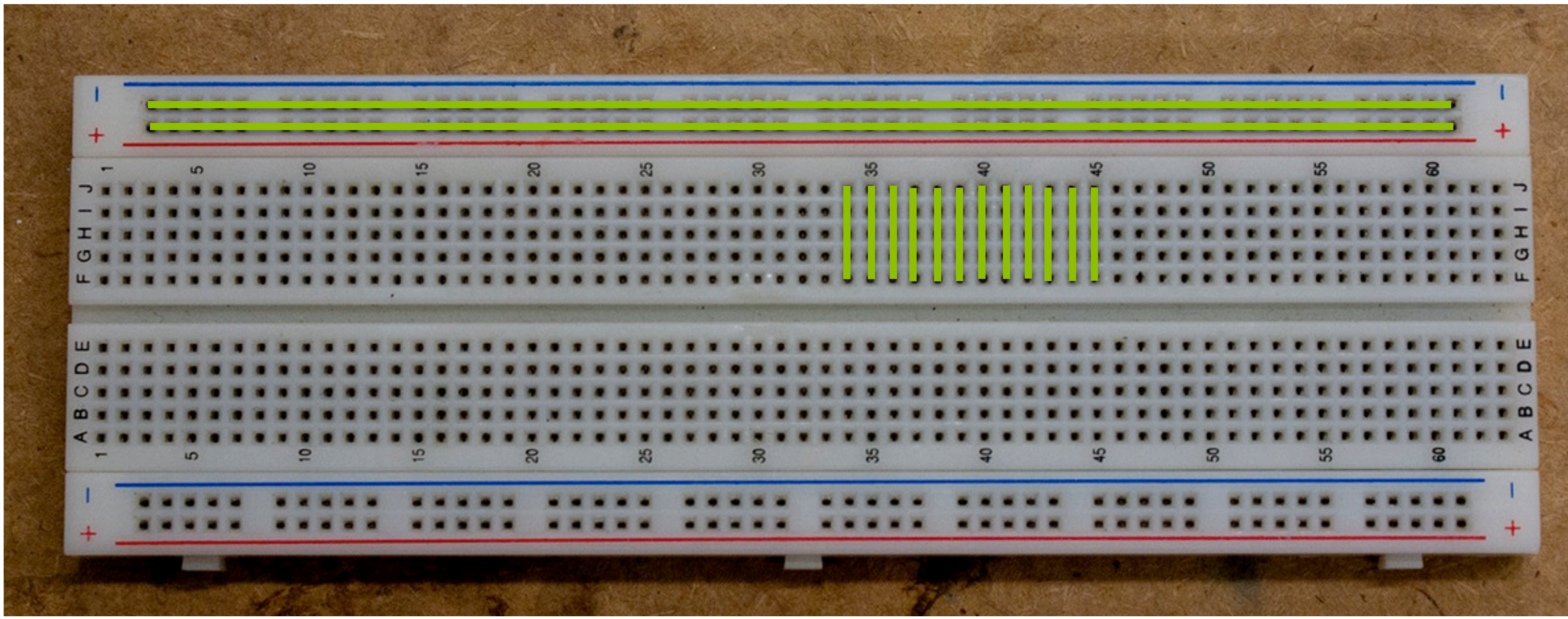
Breadboard

- Temporarily build circuits
  - – Just plug stuff in!

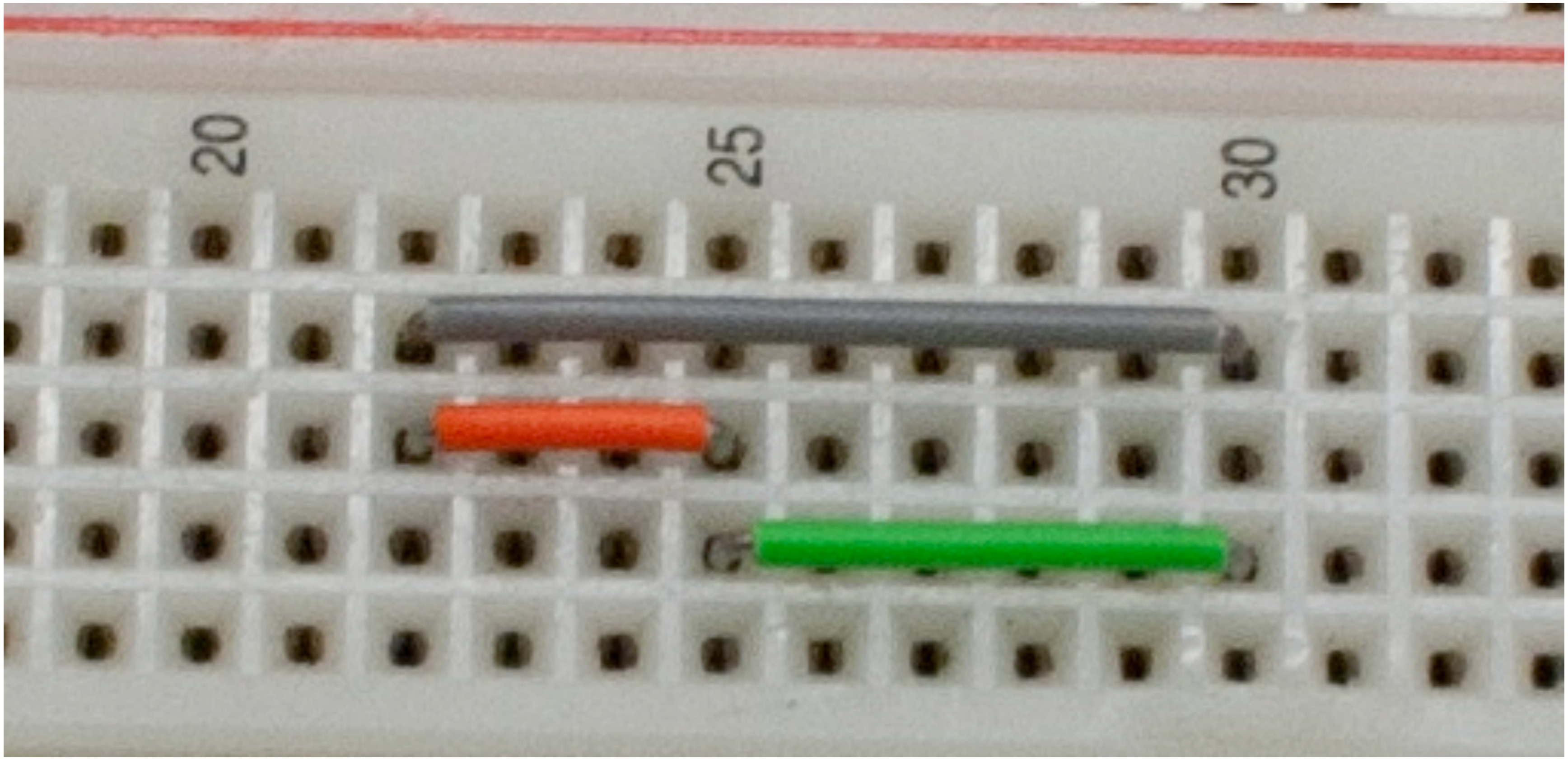
Breadboard



Some sockets are connected



Example breadboard connection



What if I mess up?

- Simple:
  - Unplug stuff
  - Plug it back in

Should I use this for everything?

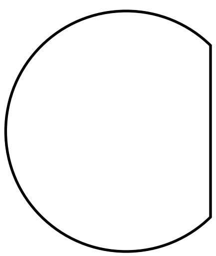
- Probably not
  - Issues at high frequencies
  - Might melt at high power
  - Can get expensive
  - Not very permanent

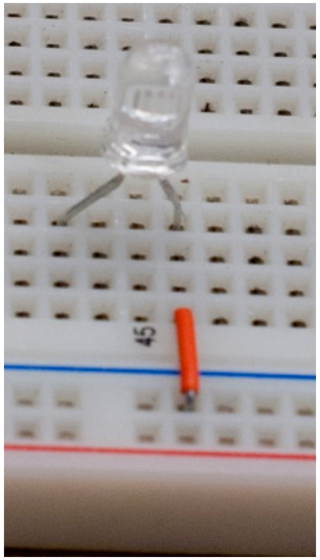
LED

- **L**ight-**E**mitting
  - Shiny
- **D**iode
  - Current only flows in one direction

Hands-on: Plug it in

- Put each lead in a different row
- Add a wire from the flat side's row to ground





Batteries

- Constant (sort of) voltage source
- Voltage?
  - Electric potential difference
  - Potential energy that can move charge around
    - Think about gravitational potential energy

More on voltage

- Common analogy: Water
  – Current is like water flowing
  – Voltage is like the *difference* in water pressure
    - Water flows from high pressure to low pressure
    - Charges move from high potential to low potential

Batteries

- Voltage is supposed to be constant
  - But it decreases over time
  - When it gets too low, the battery's "dead"

Combining batteries

- Series
  - Add all of the voltages together
  - Goes dead just as quickly

- Parallel
  - Takes longer to go dead
  - Voltage doesn't increase

Combining batteries

- This explains your devices' battery holders

Combining batteries

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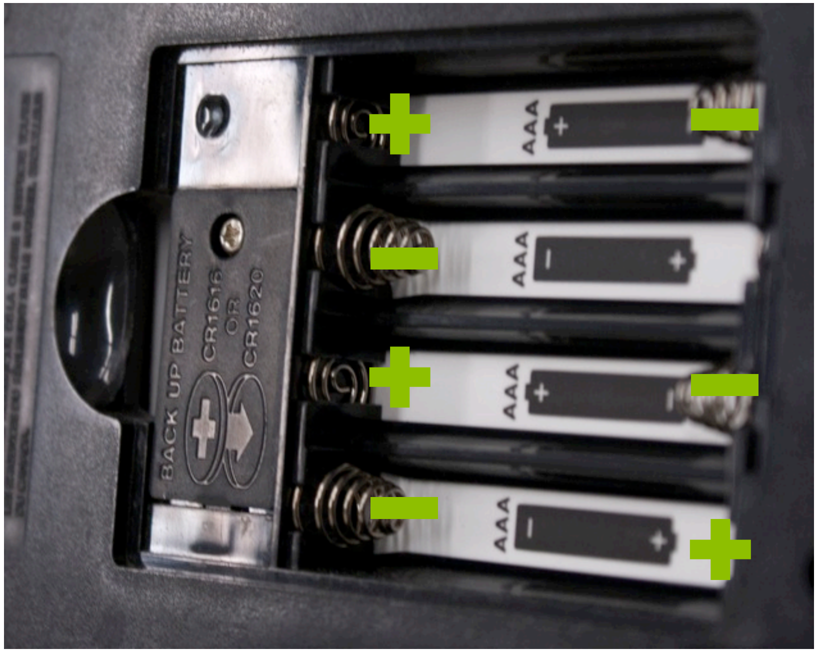
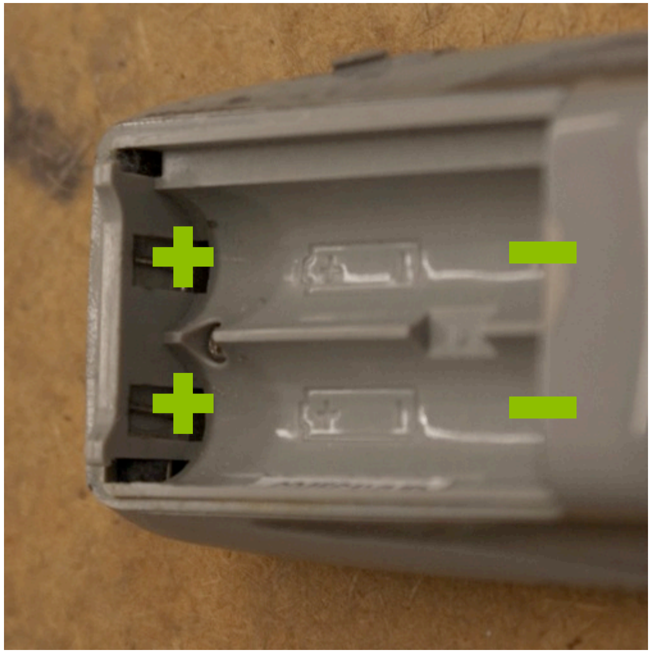
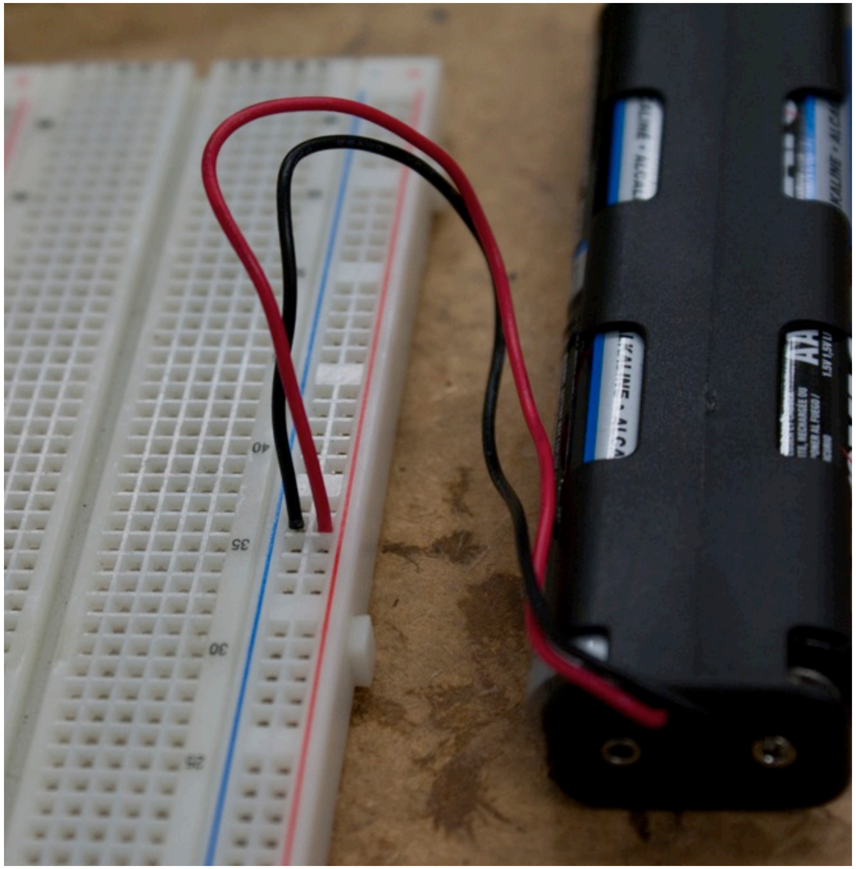




Here you go

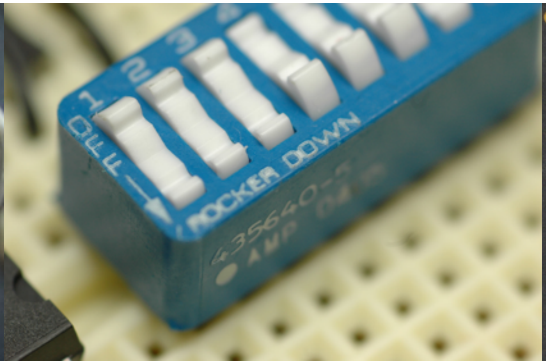
- You have a battery holder
- Four AAs (~1.5 V) in series = 6 V (ish)
- Connect it to the breadboard



Switches

- Connect or disconnect things
  - Make or break circuits
- Come in all shapes and sizes

http://www.flickr.com/photos/harvypascua/46114061/



http://www.flickr.com/photos/bichromephoto/3202095140/

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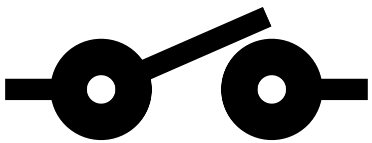
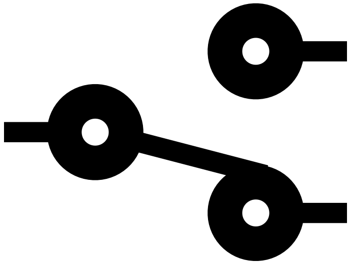
Switches

- Simplest: “Single pole, single throw”
  - Just connects or disconnects the two ends
  - Most home light switches are like this



Switches

- Next one up: “Single pole, double throw”
  - Connect one end (“common”) to either of two things on the other end
  - Useful for forward/reverse controls
  - You’ve got one of these

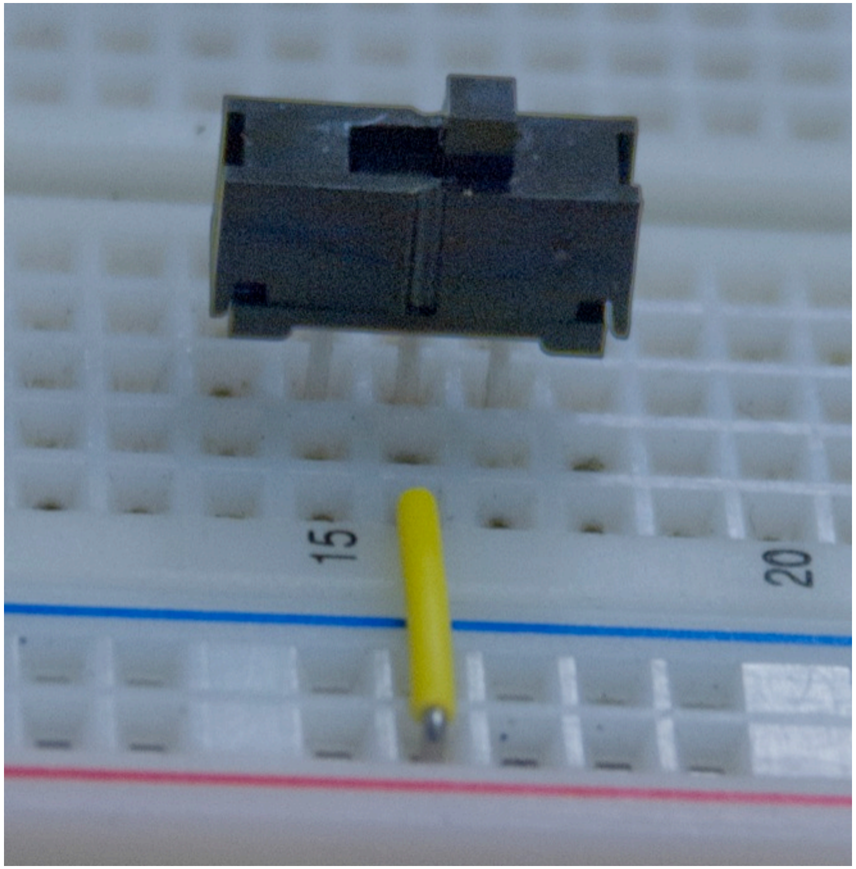


Switches

- These concepts scale up
  - Triple pole, single throw:

Here you go

- You have an SPDT slider switch
- Add it to your breadboard
- Connect common terminal (center pin) to +



Resistor

- Very basic circuit element
- Can be used to control amount of current
  - We can avoid burning out our LED!

Ohm's Law

- $V = I \times R$
  - Voltage across an element is proportional to the current flowing through it
- For a given voltage across an element:
  - As current goes up, resistance goes down
  - As current goes down, resistance goes up

Water analogy again

- Think of resistance like your pipe diameter
  - Narrower pipe = greater resistance
    - Less water flowing for the same pressure difference

Using resistors with LEDs

- An LED always maintains the same voltage across it
  - This one: 1.85 V
- Battery voltage - LED voltage = resistor voltage
  - 6 V – 1.85 V = 4.15 V

Using resistors with LEDs

- How much current should go through this circuit?
  - LED manufacturer suggests 20 mA
- Ohm's Law: V = I x R (or R = V / I)
  - 4.15 V / 0.02 A = 207.5 Ω
    - Don't have this, so we'll go with the next highest one we've got (220 Ω)

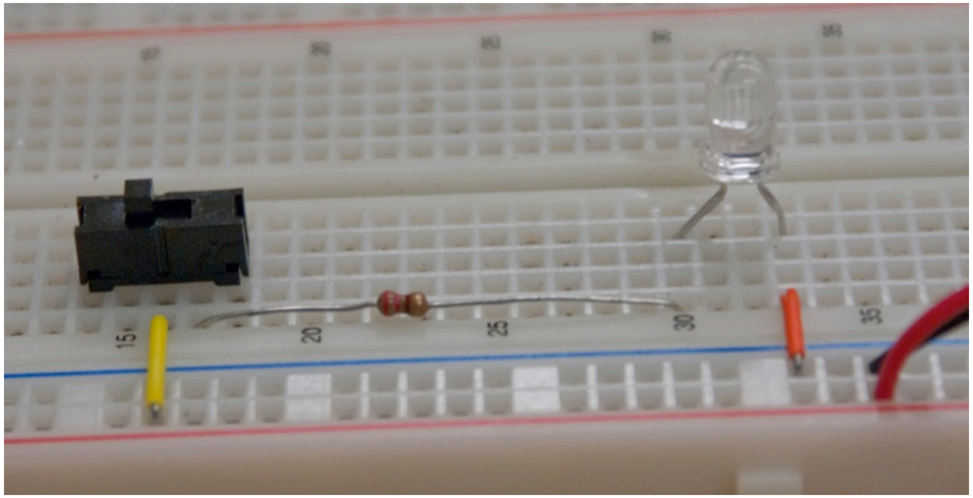
How do we find a 220 Ω resistor?

- Color codes
  - Each color has a different meaning
  - Look them up:
    - http://www.okaphone.nl/calc/resistor.shtml
    - http://www.bobborst.com/tools/resistor-color-codes/

 = 220 Ω

Plug it in!

- Add one to your breadboard
- Connect one end of your switch to the round side of your LED



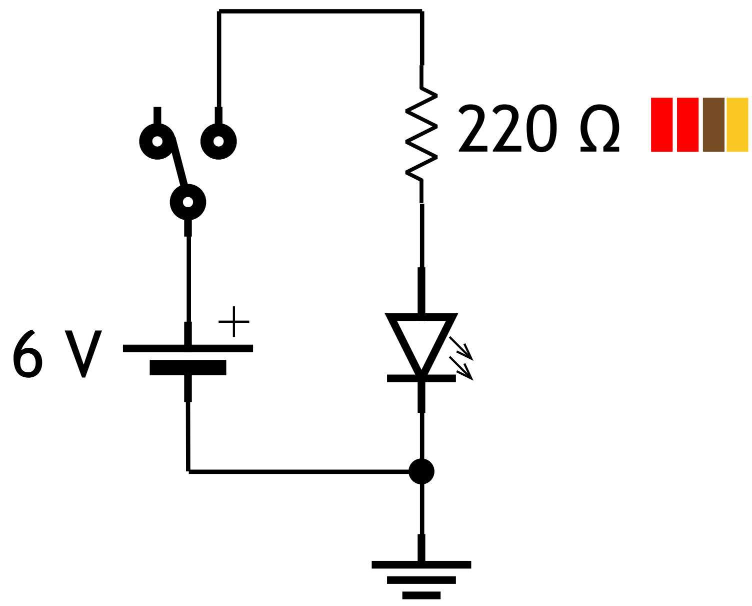
Congratulations

- You have a circuit!
- Flip the switch a few times
  - Watch the LED turn on and off

Schematic

- What if we want to write down how these are connected?
  - Refer to it later
  - Help describe it to a friend
- Simplified diagram with symbols for each component

Today's schematic



That’s it for tonight

- Next week
  - Power supplies
  - Integrated circuits
  - How to use test equipment
- If possible, keep tonight’s project assembled