Intro to Electronics

Week 3

Thanks to EMSL for the idea:
http://www.evilmadscientist.com/article.php/nightlight

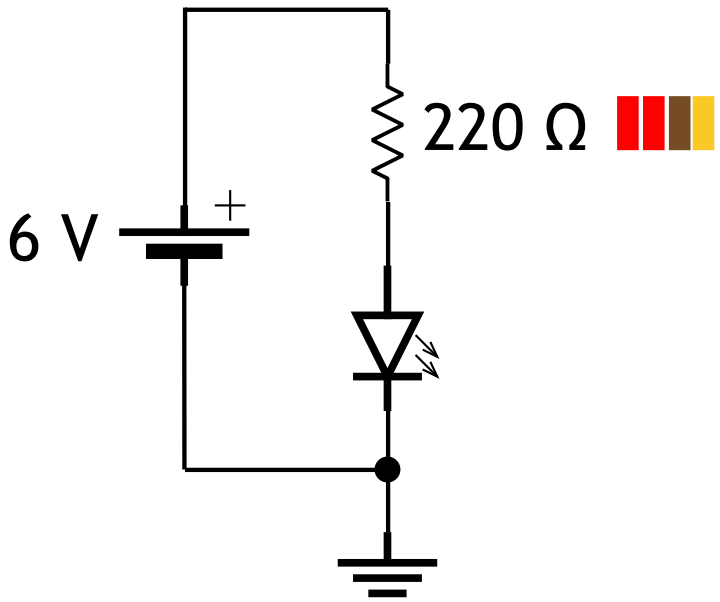
Make a night light

TODAY'S PROJECT

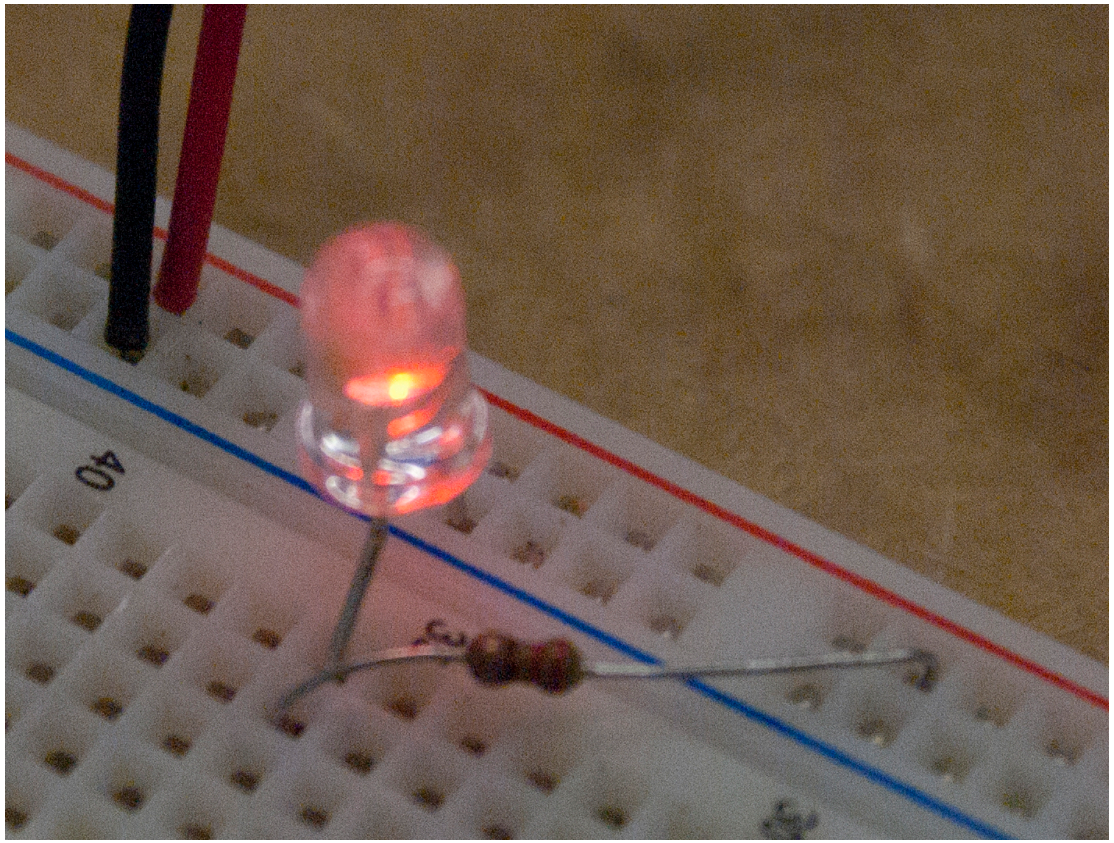
LED

- Remember these?
- What does it take to light one?

Go ahead and do it



Go ahead and do it



Transistor

- “The fundamental building block of modern electronic devices” (Wikipedia)

Why so important?

- Amplification
  - Make a small input change cause a large output change
  - Useful for audio and radio

Why so important?

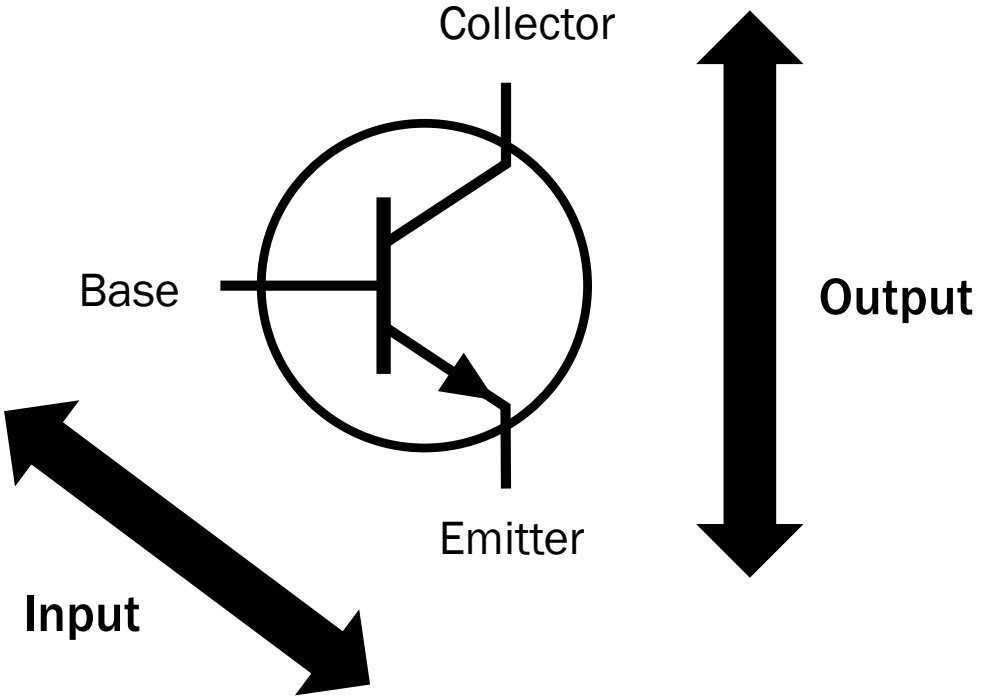
- Switching
  - Control whether something else turns on or off
  - Useful for digital logic and control

Bipolar junction transistor

- Common transistor type
  - Only one we'll use in this class
  - We'll just use it for switching

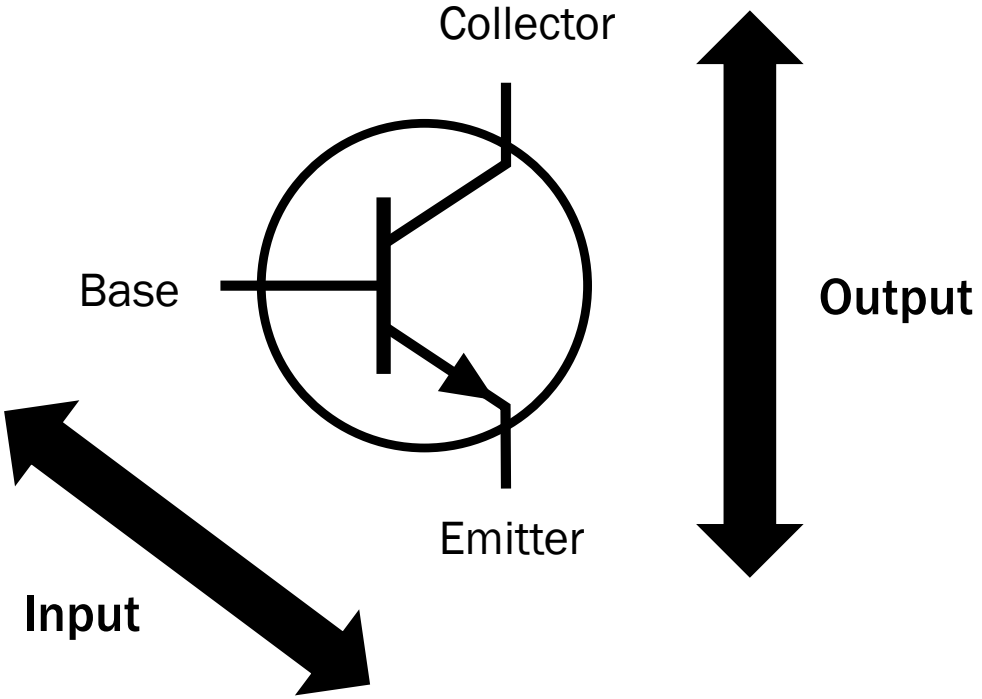
BJT

- Three terminals
  - Base
  - Emitter
  - Collector

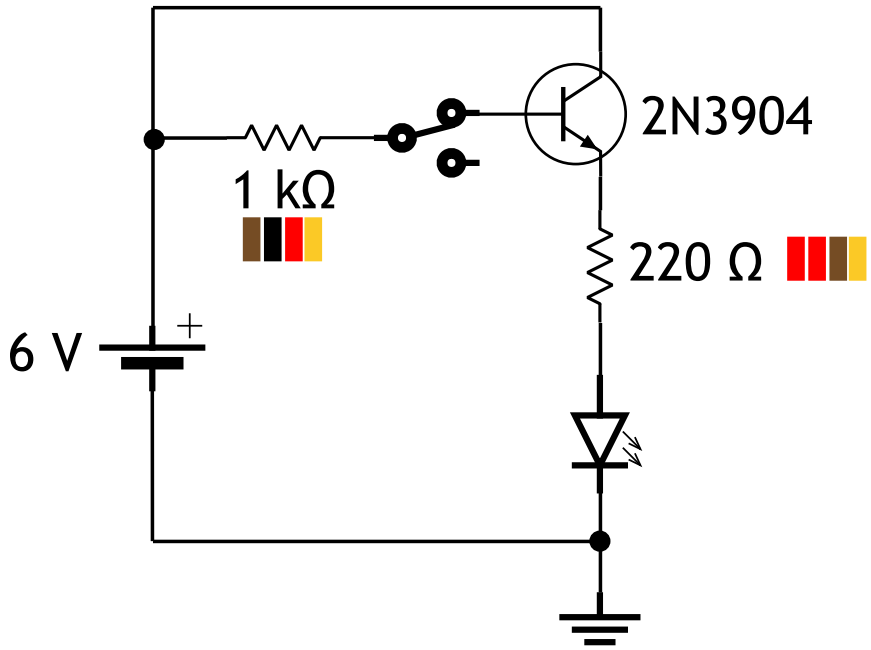


BJT

- Current flows into base
- Transistor allows current to flow into collector
- Both currents come out the emitter
  - Hence the arrow pointing out



Let's add one

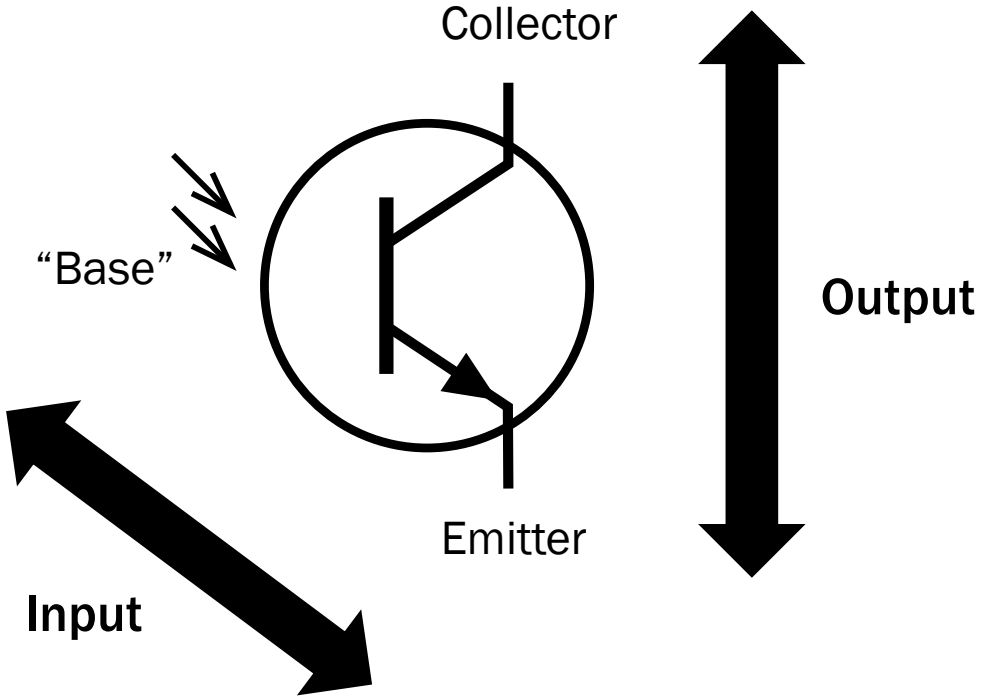


Sort of boring, right?

- No real difference from before
  - Switch turns transistor on and off
  - Transistor turning on and off makes LED do the same
- Need another way to control the transistor

Phototransistor

- Instead of supplying base current, shine a light on it!



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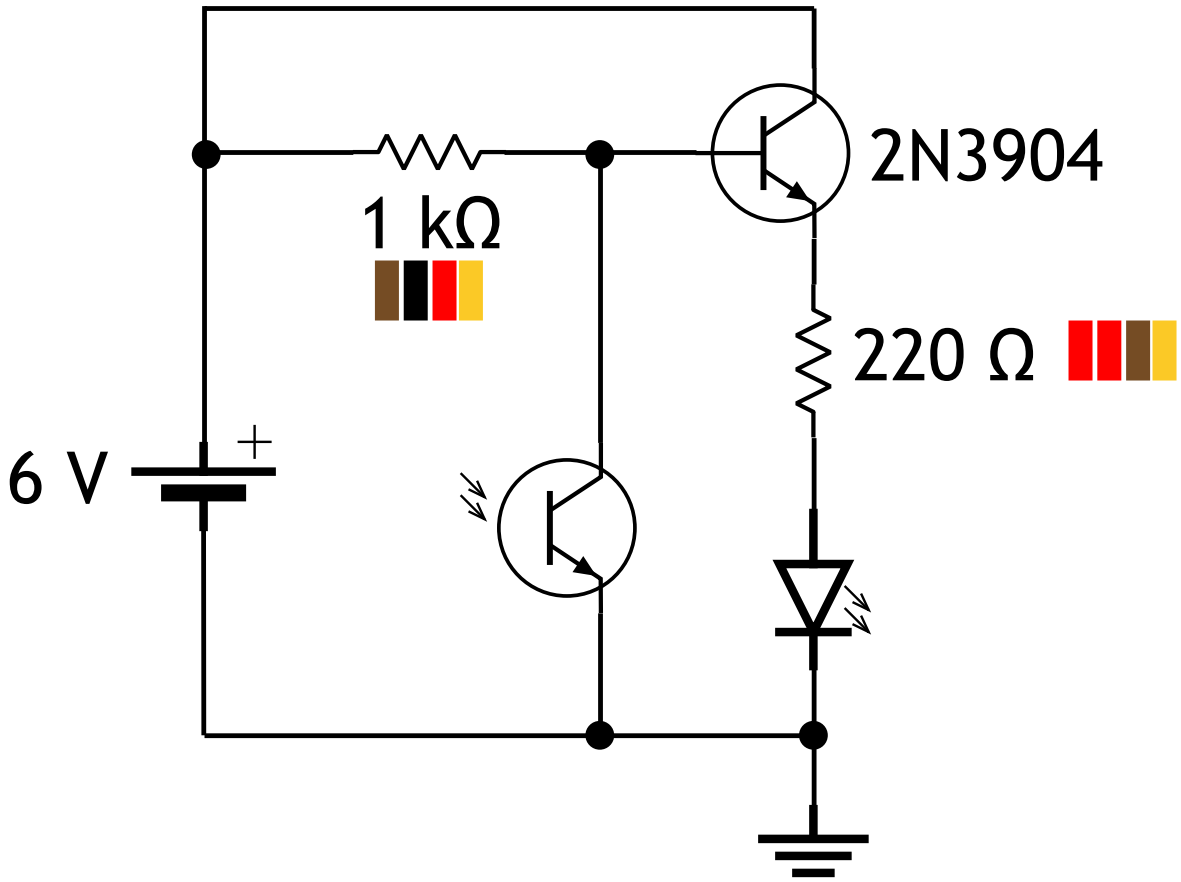

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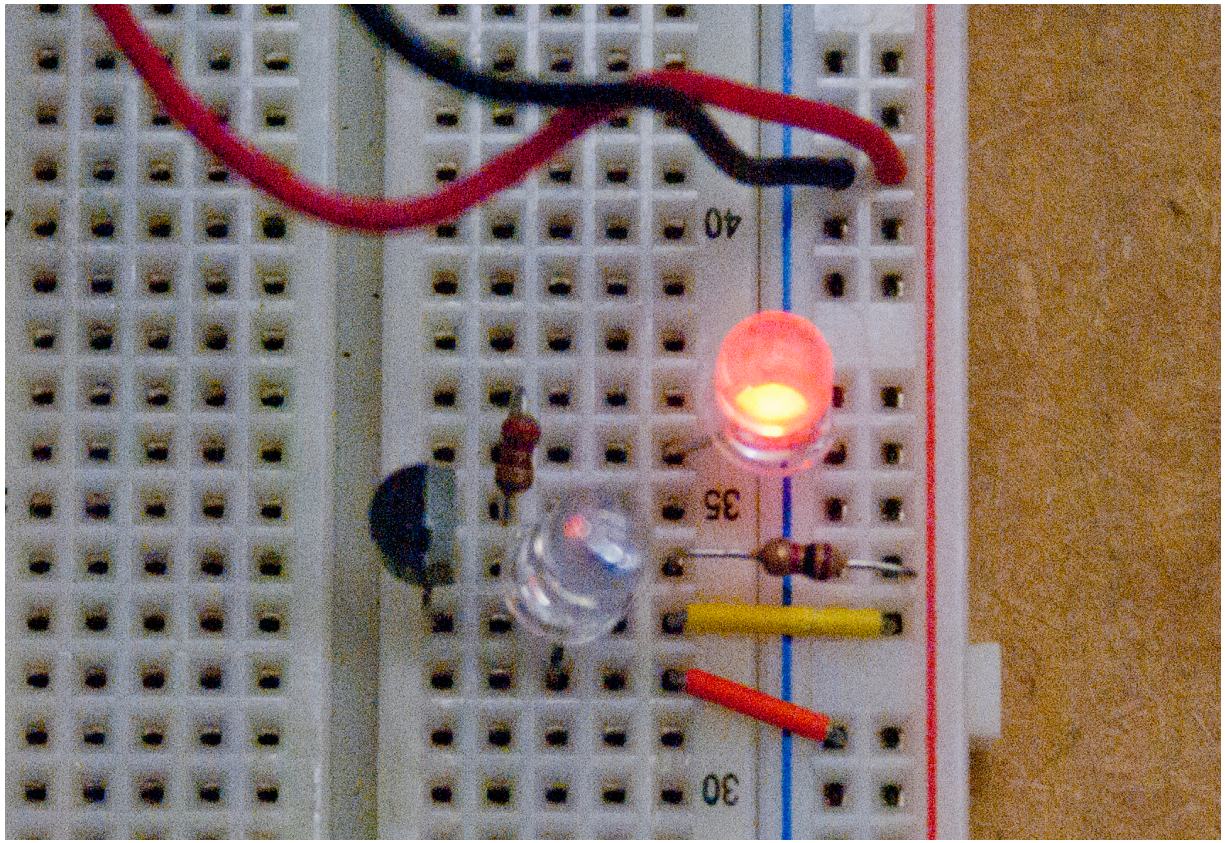


What happens?

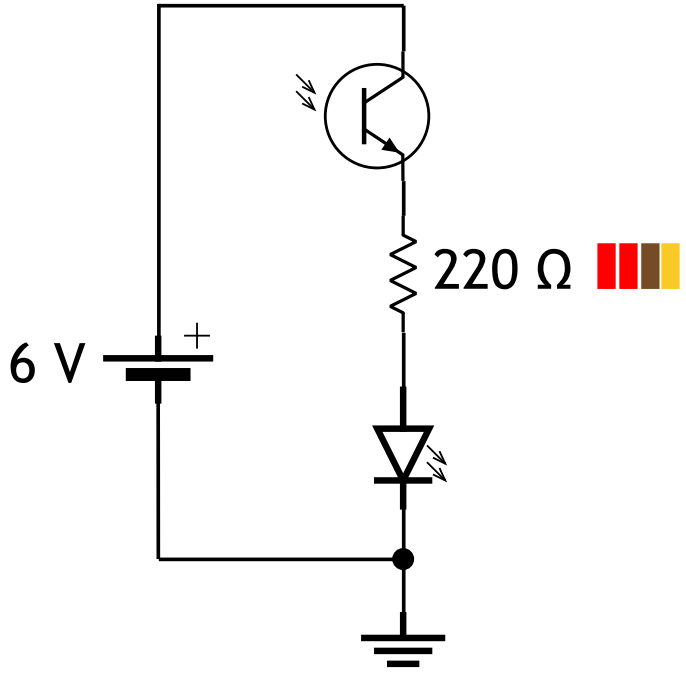
- Light shines on the phototransistor
- Base current no longer goes to BJT
  - Goes straight to ground instead
- BJT turns off ➔ LED turns off

Why isn't this working?

- Phototransistors tend to be sensitive to just one kind of light
  - In this case: Infrared (most common case)
- Fluorescent lights don't put out much infrared
  - Try another light (or the sun!)

Why two transistors?

- Without them, we'd have a day light, not a night light



A thought

- We just used one transistor to control another transistor!
  - Beginning of digital logic

Digital logic

- Combine switches to do exciting things!
- Basic building blocks: Logic gates
  - Can be made entirely of transistors

Logic gates

- Take one or more inputs
- Follow some sort of rules
- Produce an output

Examples

- AND gate: Two inputs
  - If they're both on, the output's on
  - Otherwise, the output's off
- OR gate: Two inputs
  - If either one is on, the output's on
  - Otherwise, the output's off

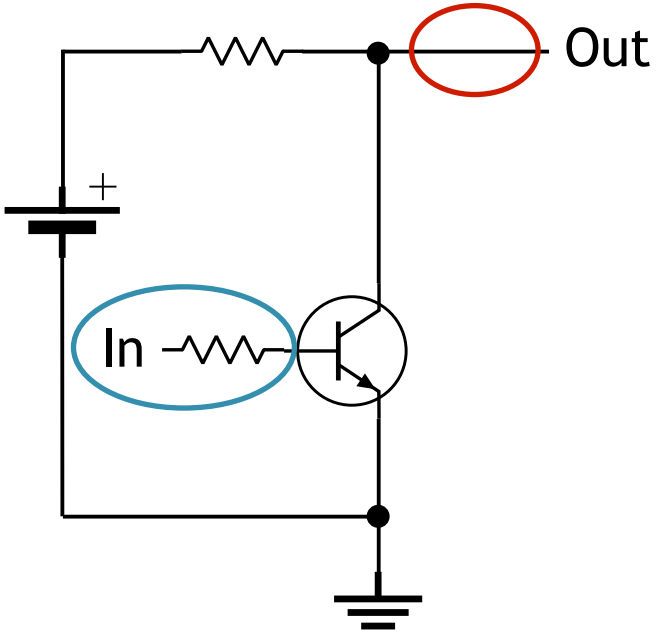
Examples

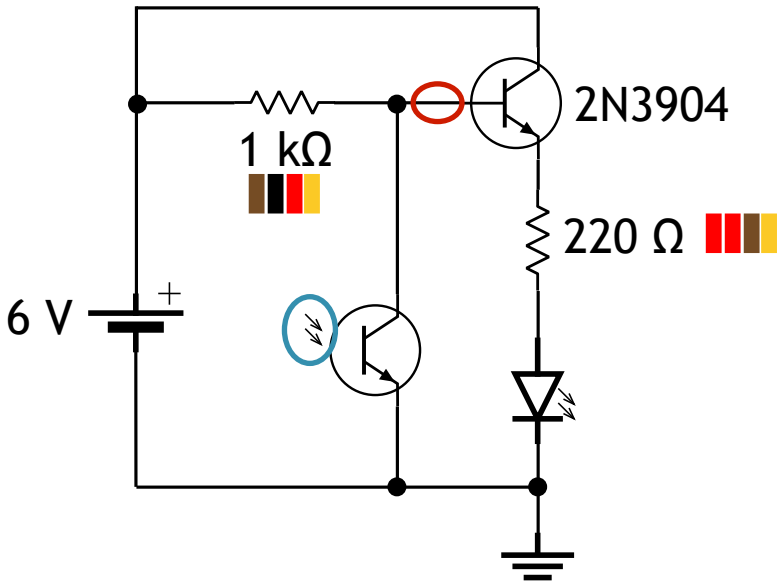
- NOT gate: One input
  - If it's on, the output's off
  - Otherwise, the output's on

Back to the night light

- You just made a NOT gate!
  - If the input's on…
    - There's ambient light
  - …the output's off!
    - The LED stays unlit
  - If the input's off…
    - There's no ambient light
  - …the output's on!
    - The LED lights up

Compare





http://www.kpsec.freeuk.com/trancirc.htm#inverter

Remember this

- We'll do more with logic in a couple of weeks
  - We'll use premade gates and such, though

That's it for tonight

- Next week
  - Oscillators
  - Timers