

Just for fun

What would happen if you put a **toaster** in your **freezer**?

Does the toaster win?

Does the freezer win?

Some sort of mutually-assured destruction?

EN 1: Engineering in the Kitchen

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Electrical circuits

ES 3: Intro to electrical systems

EE 20: Introduction to circuits

EE 22: Electronics

ME 30/31: Electromechanical systems

Embedded systems

ES 4: Intro to digital logic

EE 14: Embedded systems

EE 25: Computer organization

Sensors

ME 70: Instrumentation

Networking/IoT

EE 129: Computer networks

CS 112: Networks

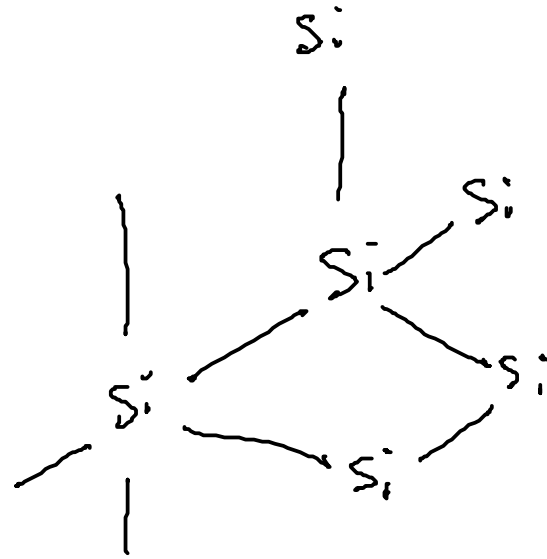
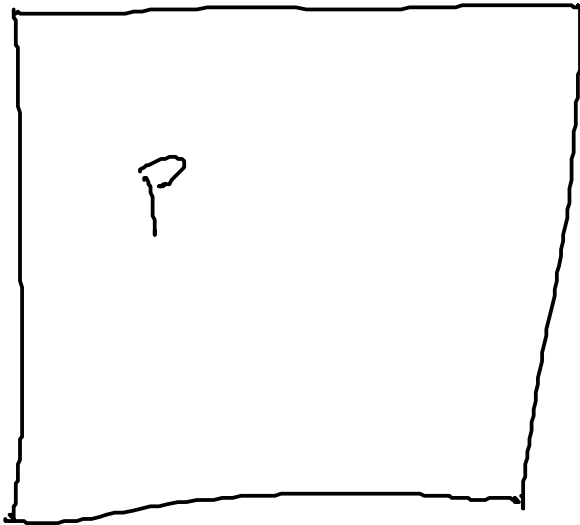
Controls

EE 105: Feedback control systems

ME 80: System dynamics and controls

What is a semiconductor?

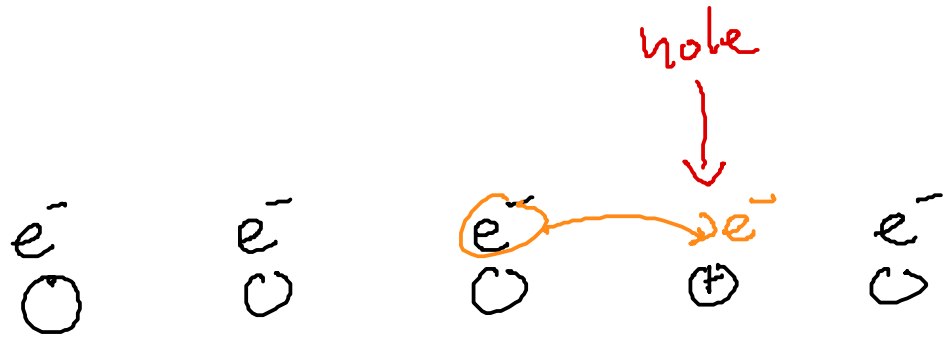
(Veritasium) <https://youtu.be/IcrBqCFLHIY?t=60>



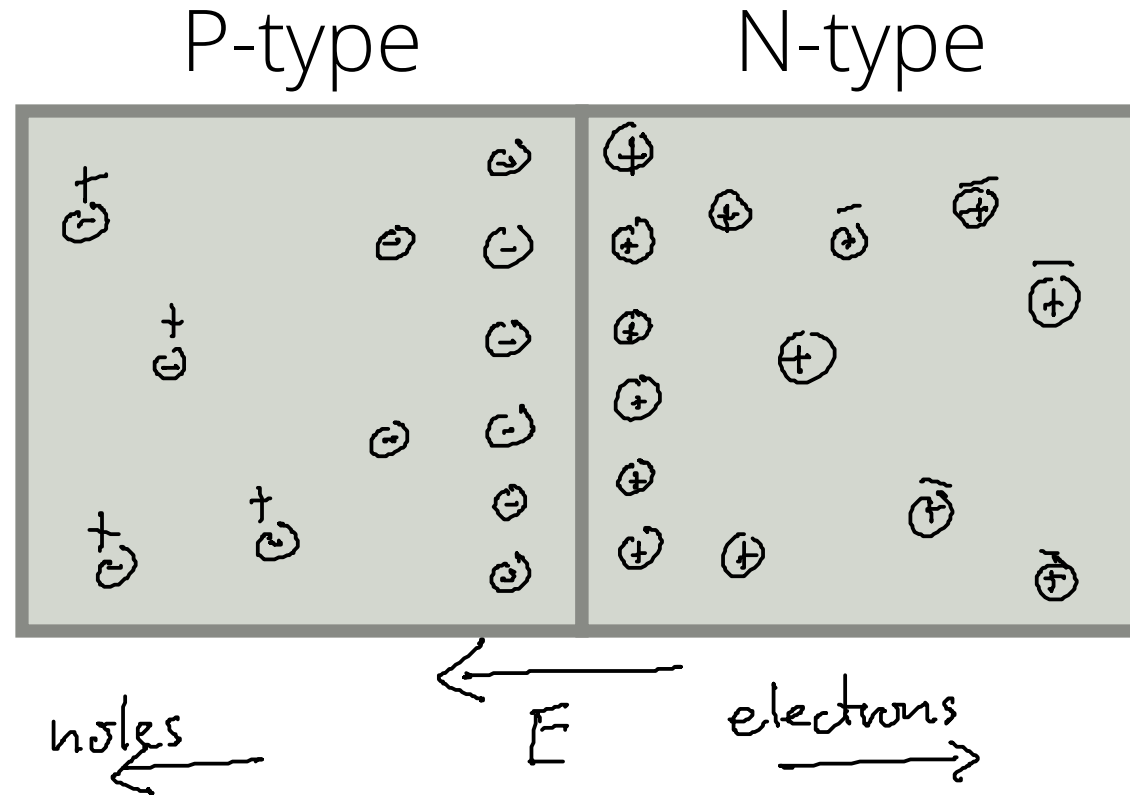
Two types of silicon doping

Holes???

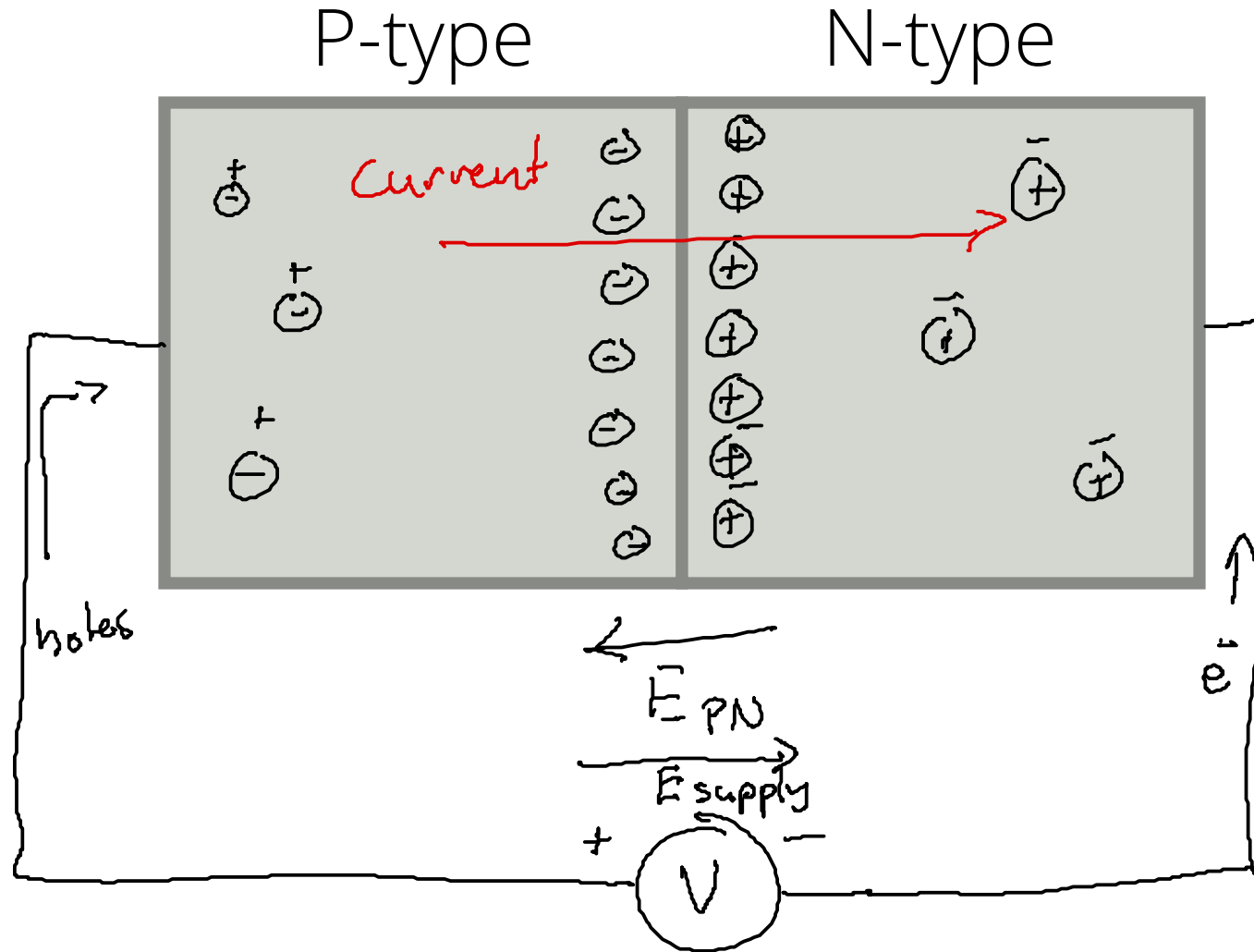
The lack of an electron is a "hole", and it can "move around" as electrons jump from one atom to another.



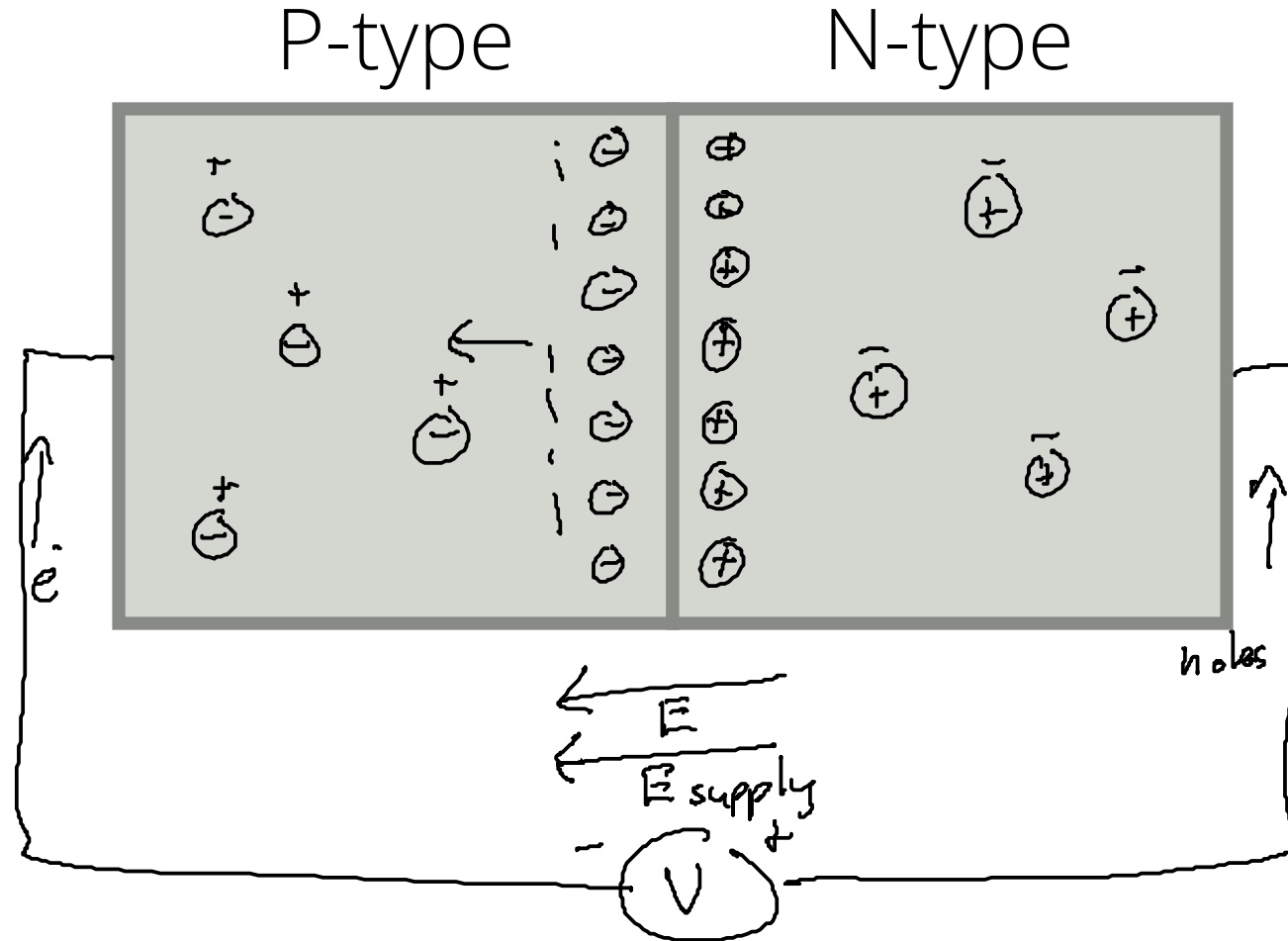
Making a PN junction



Connecting a voltage source



Connecting a voltage source

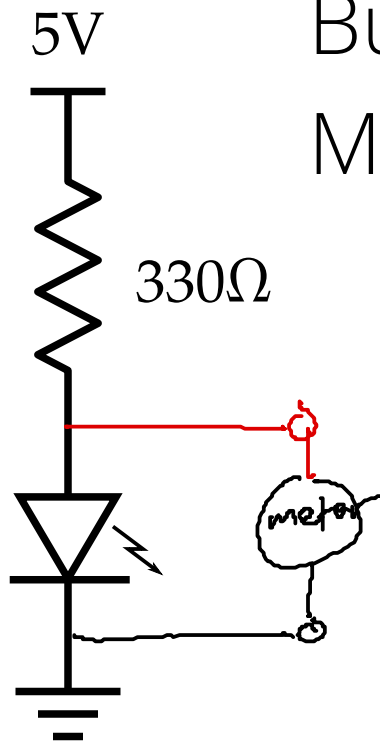


Forward voltage

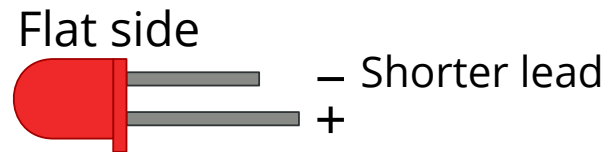
How much voltage does it take to overcome the "gap"?

You have some diodes in your lab kit - **L**ight **E**mitting **D**iodes

U_{in} on ESP32



Build this circuit, using the 5V/GND from your ESP32
Measure the voltage across the LED



LEDs have polarity!
(and now you know why!)

How does color relate to forward voltage?

Amount of energy in a photon is

$$E = hf$$

But it's easier to talk about wavelength:

$$c = \lambda f$$
$$\frac{m}{s} = m \cdot \frac{1}{s}$$

$$f = \frac{c}{\lambda}$$

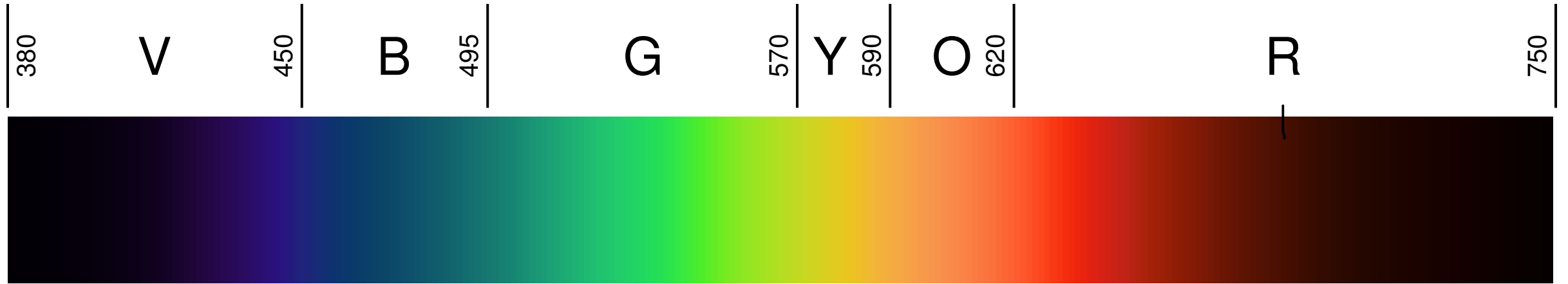
$$E = h \frac{c}{\lambda}$$
$$\lambda = h \frac{c}{E}$$

~~$$f = c\lambda$$~~

$$\frac{m}{s}$$

The visible spectrum

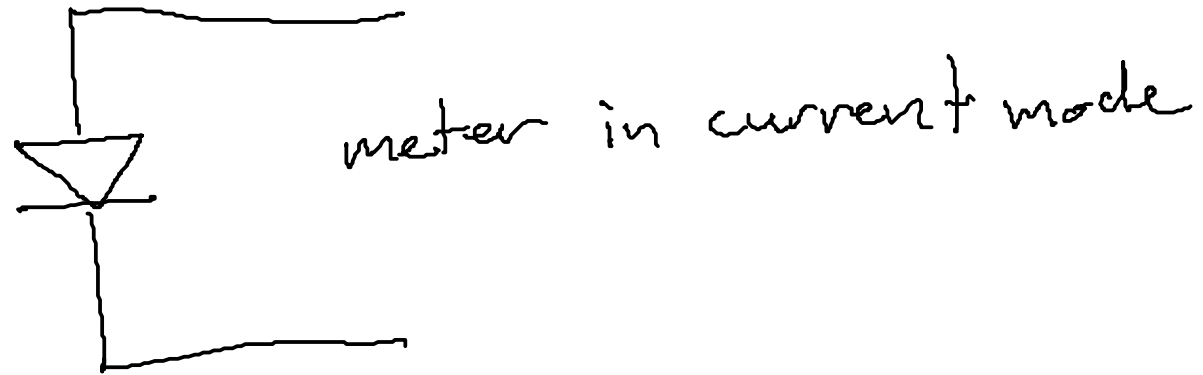
Wavelength (nm)



(wikipedia)

Does this work backwards?

Could I shine light on an LED and get electricity out?



Optimizing for capturing photons

How would you optimize a diode to make lots of electricity by capturing photons?