Rev 10: 1-May-2023

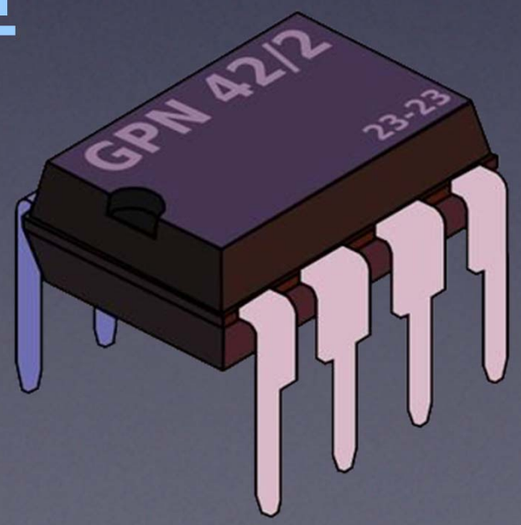
Arduino For Total Newbies

w/ TV-B-Gone as example project

Mitch Altman

Chief Scientist, **Cornfield Electronics**, San Francisco, CA
Inventor of **TV-B-Gone** universal remote controls
Co-founder of **3Ware** (successful Silicon Valley startup)
Pioneer of **VR** (in the mid-1980s)
Founding mentor at **HAX** (1st and biggest hardware accelerator)
Co-founder of **Noisebridge** (San Francisco hackerspace)

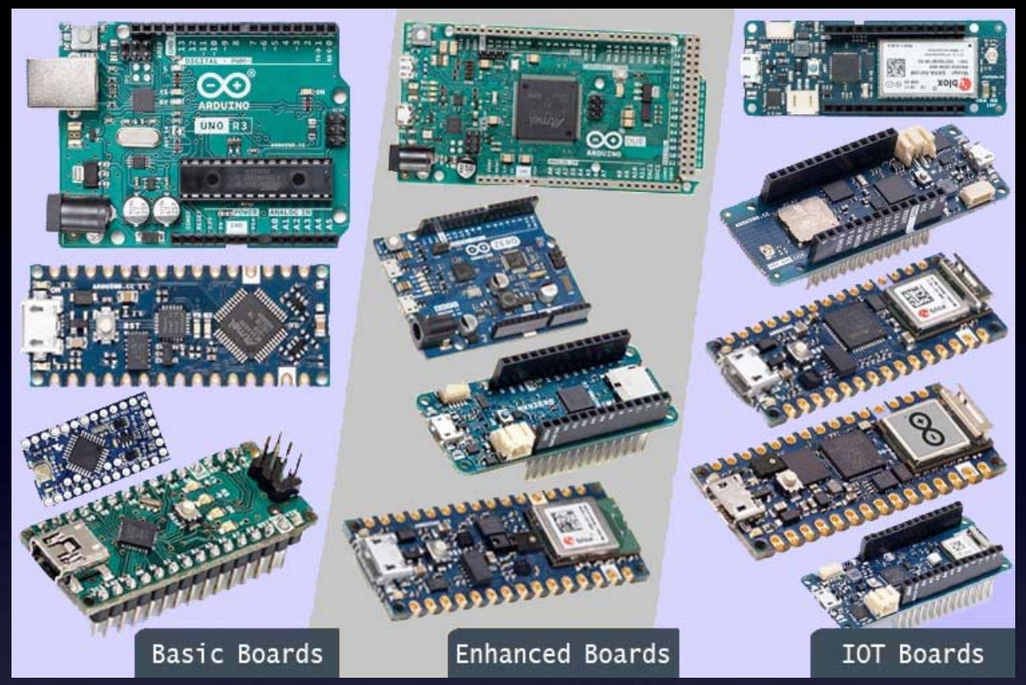
email: **mitch@CornfieldElectronics.com**
site: **www.CornfieldElectronics.com**
twitter: **@maltman23**
flickr: **maltman23**
WeChat: **mitchaltman**

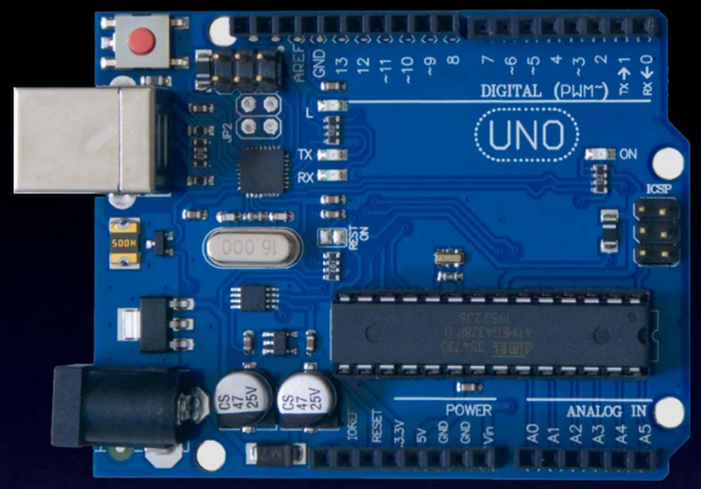


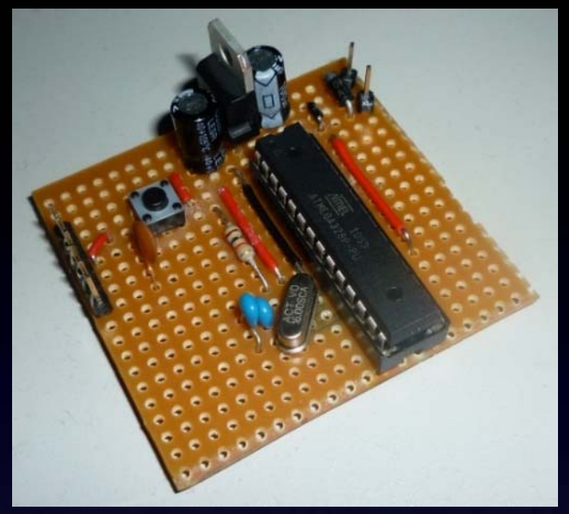
Syllabus

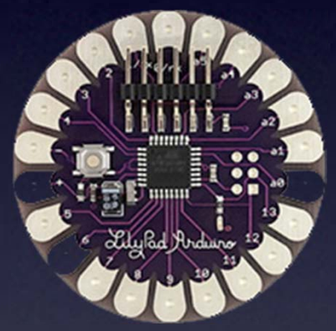
- Intro
- Everything You Need to Know About Electronics
- *[How to solder / make your own Arduino] ← not in today's workshop*
- How to Set Up and Use the Arduino Software
- How to Hack Arduino Programs ("Sketches")
- How to Use Solderless Breadboards
- How to Read a Schematic
- Make a TV-B-Gone Remote Control with your Arduino Clone without soldering

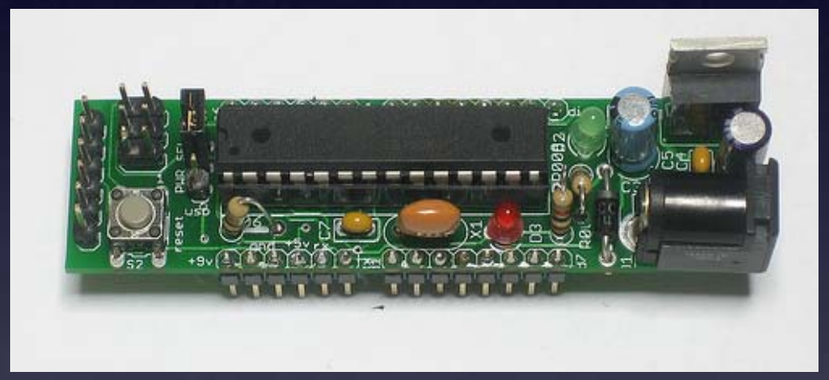
Intro

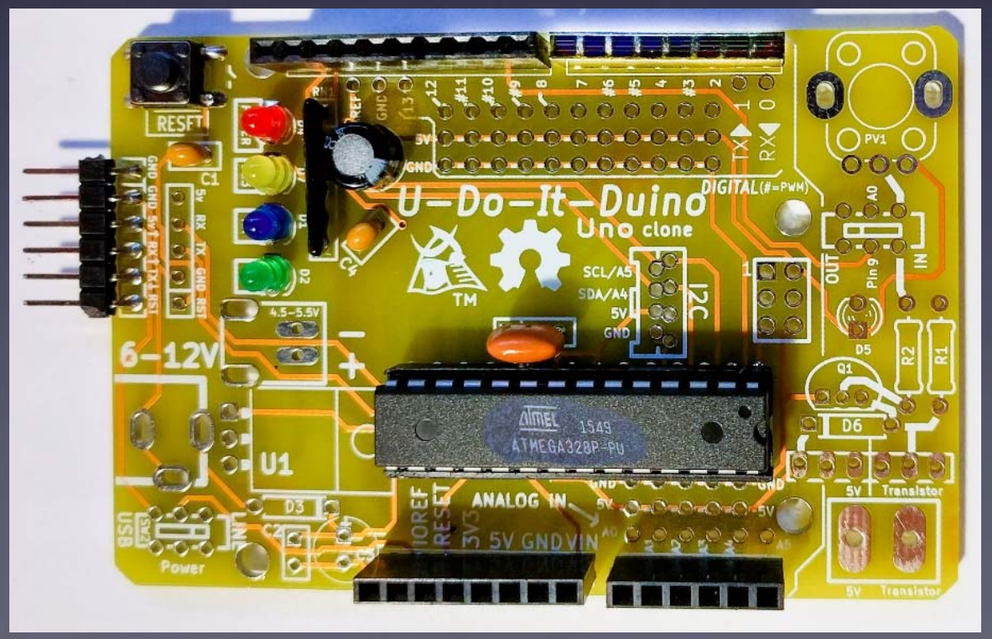

Basic Boards
Enhanced Boards
IOT Boards

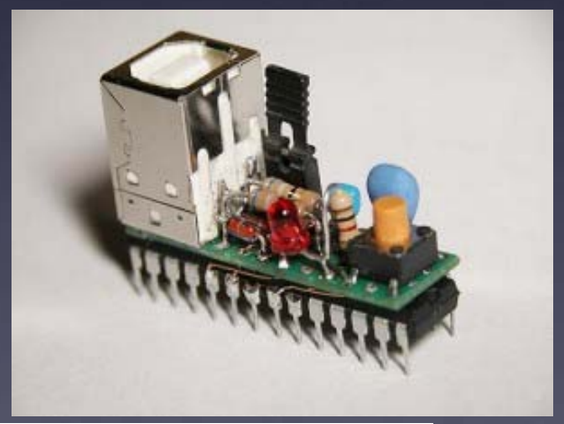

DIGITAL (PWM~)
UNO
ON
ICSP
POWER
ANALOG IN

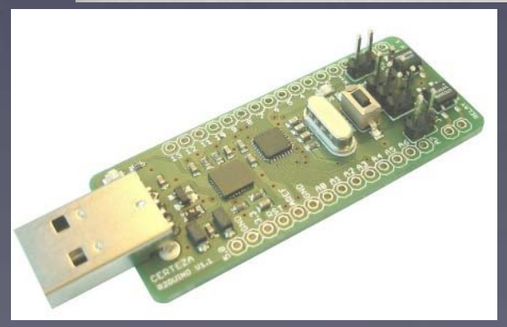



LilyPad Arduino



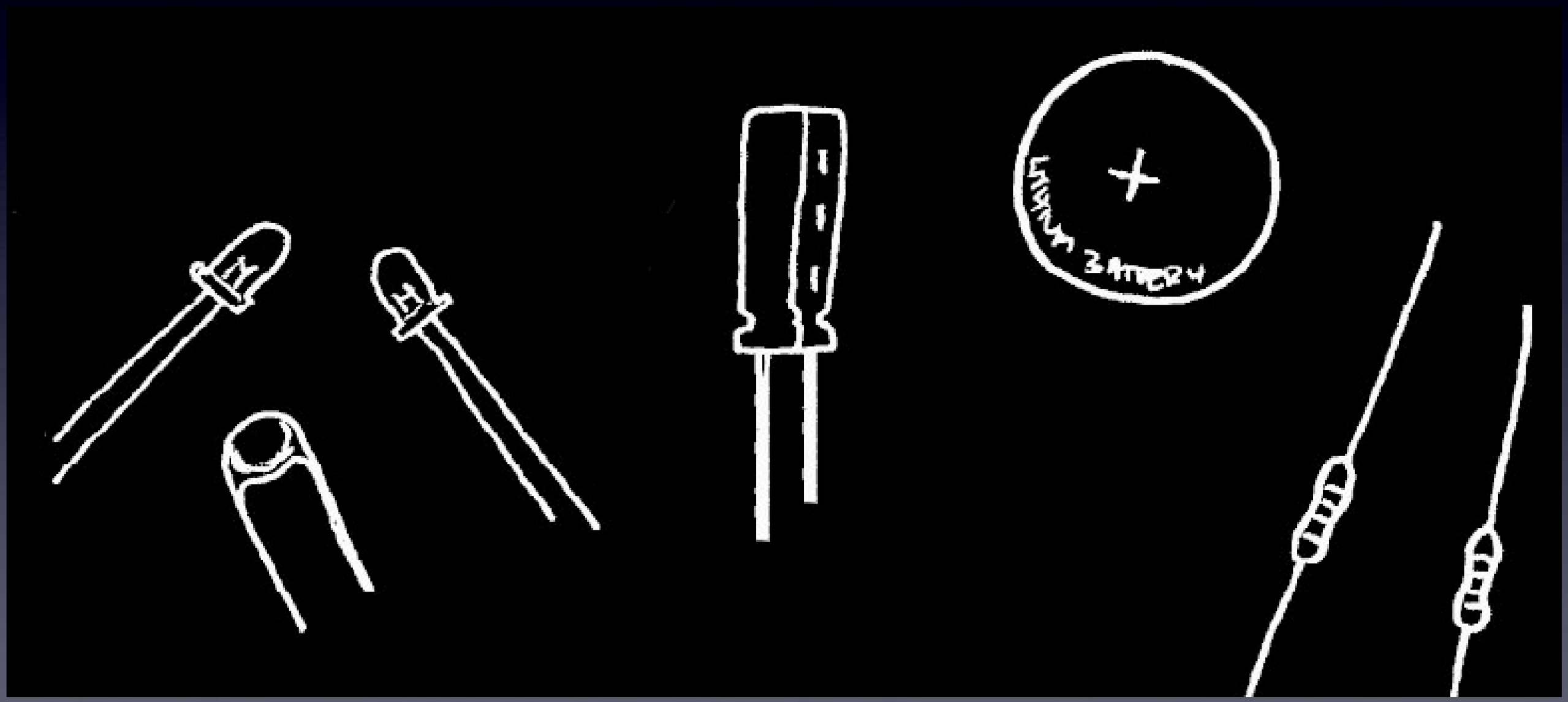

U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
SCL/A5
SDA/A4
5V
GND
I2C
6-12V
ATMEGA328P-PU
ANALOG IN
Transistor



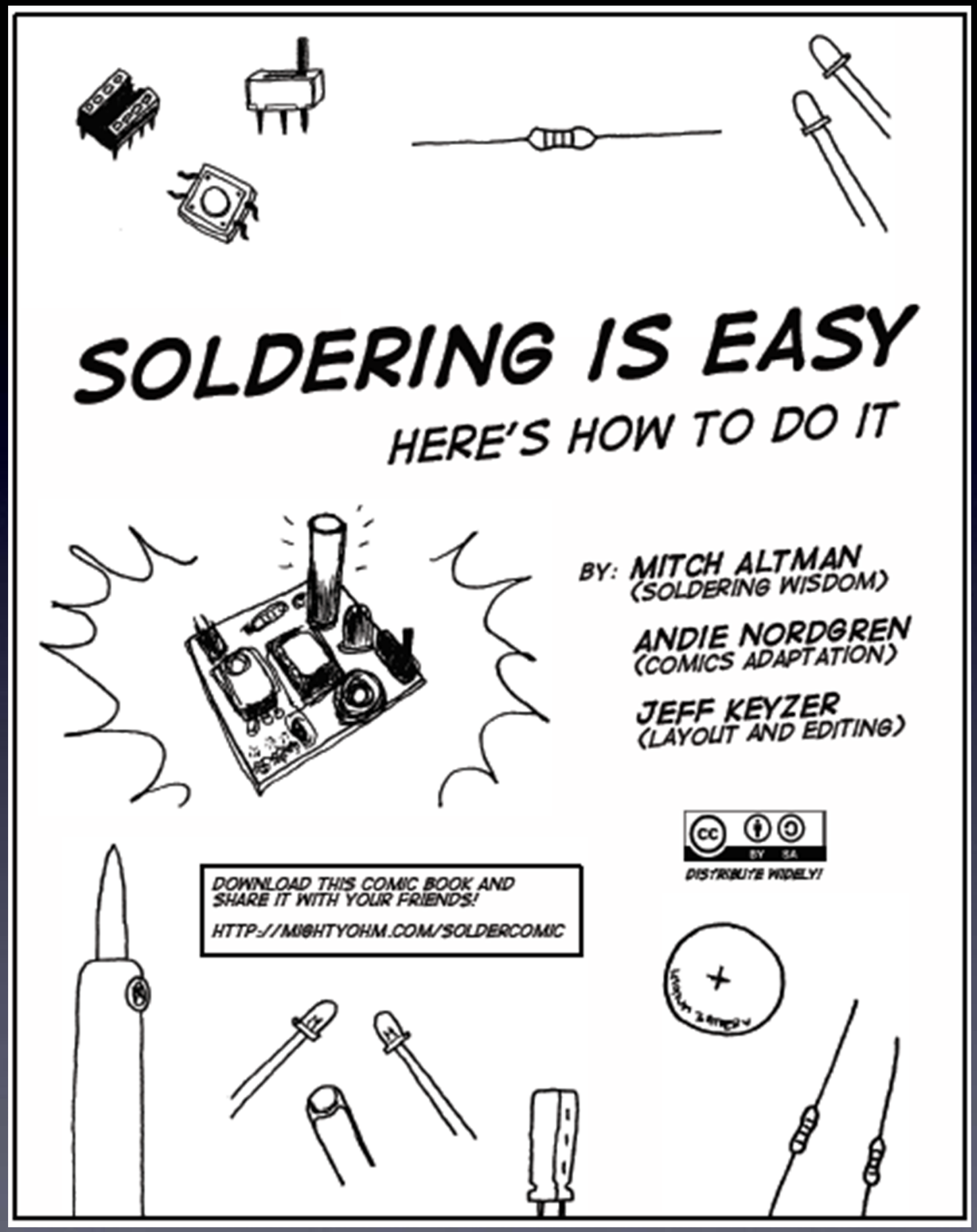



Diavolino
by Evil Mad Science

Everything You Need to Know About ***Electronics***



Learn To Solder



download for free at:
http://mightyohm.com/soldercomic

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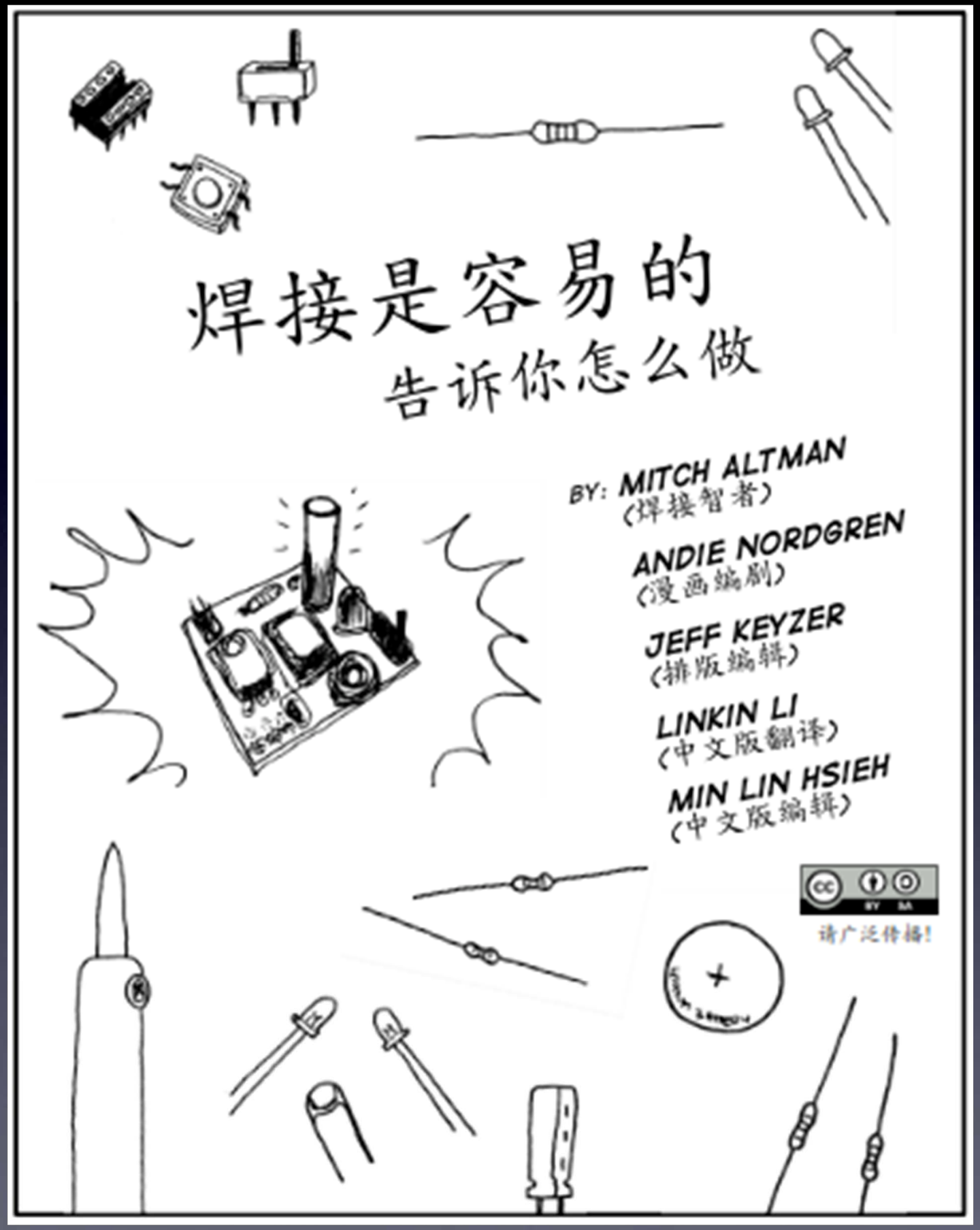

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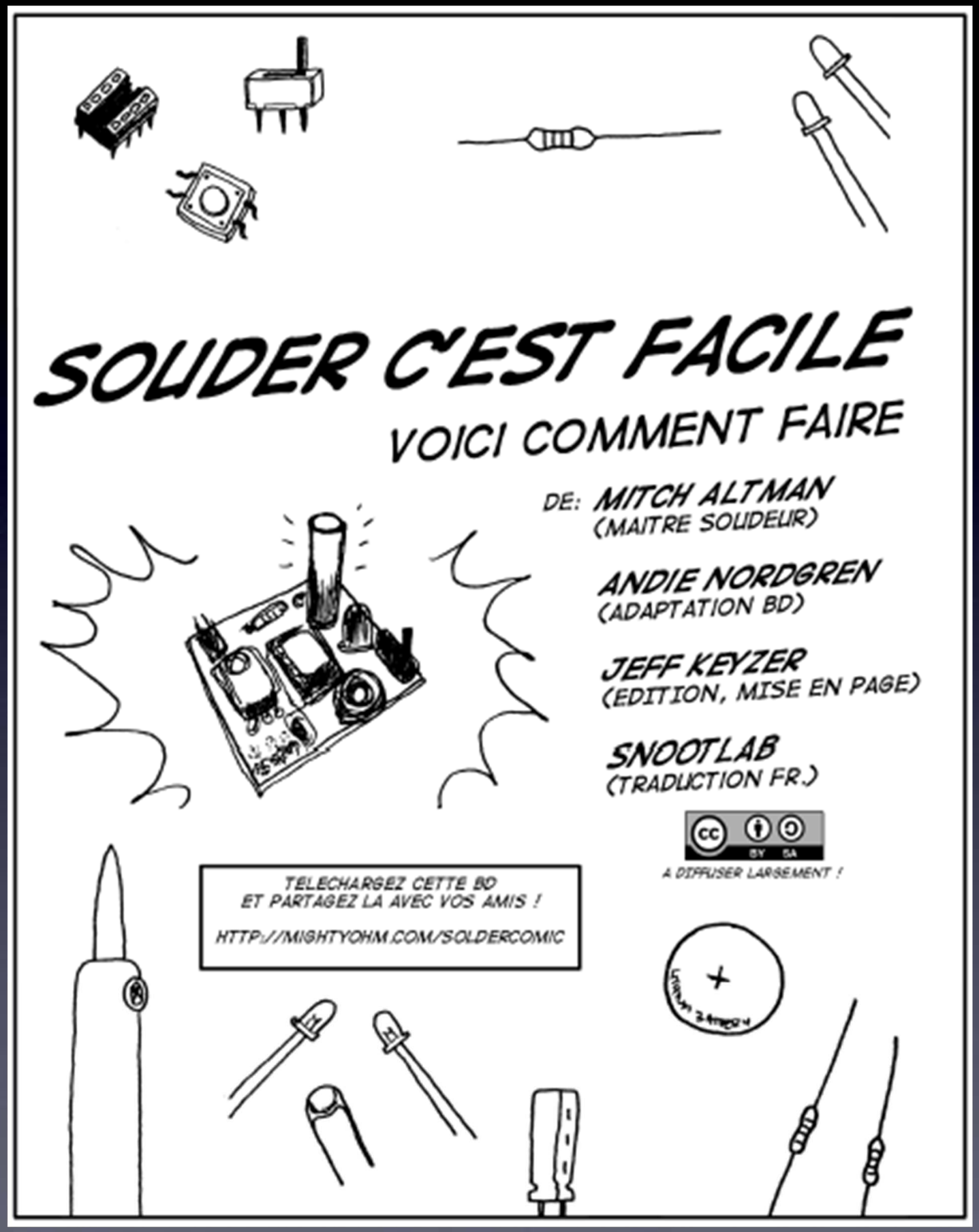

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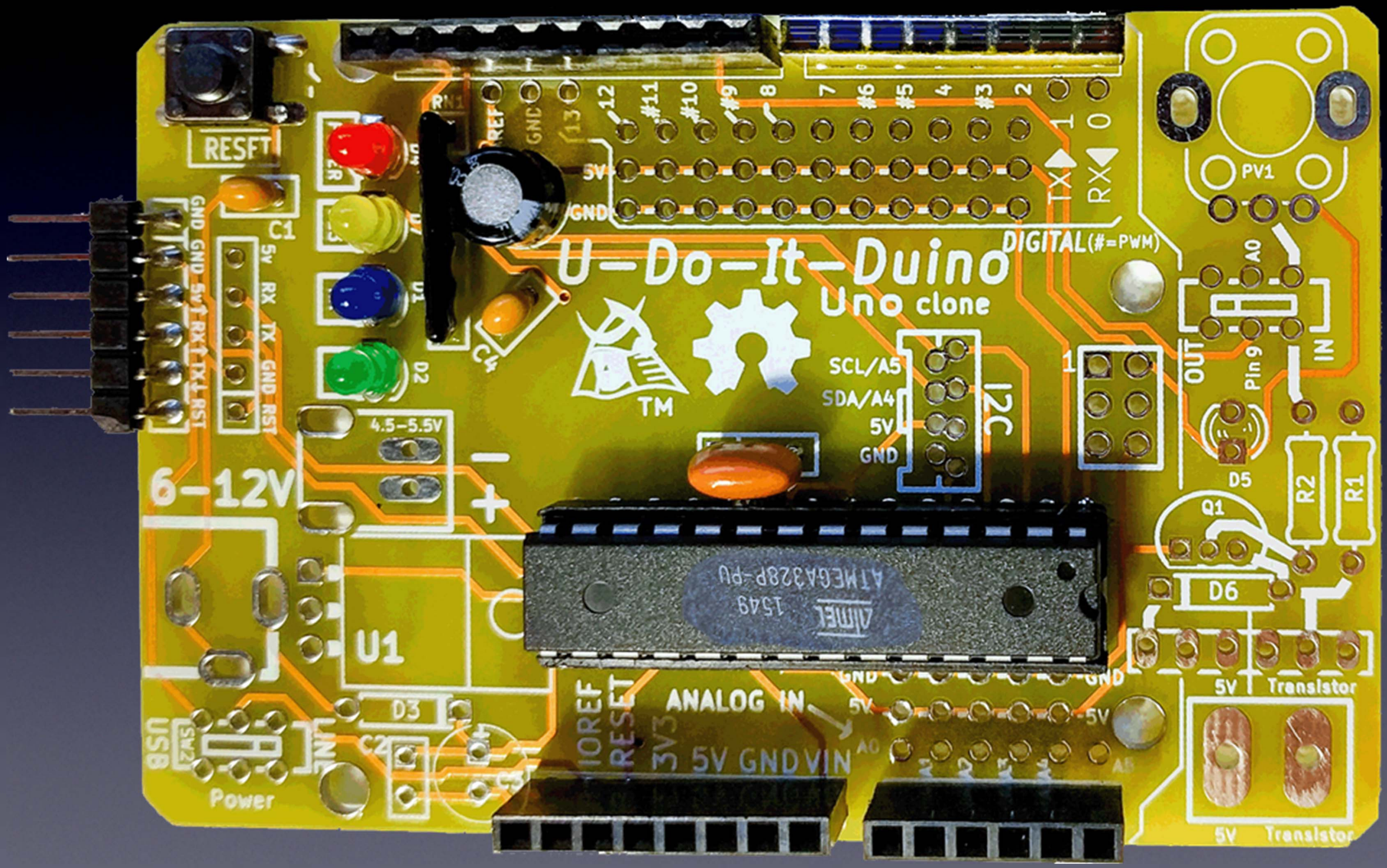
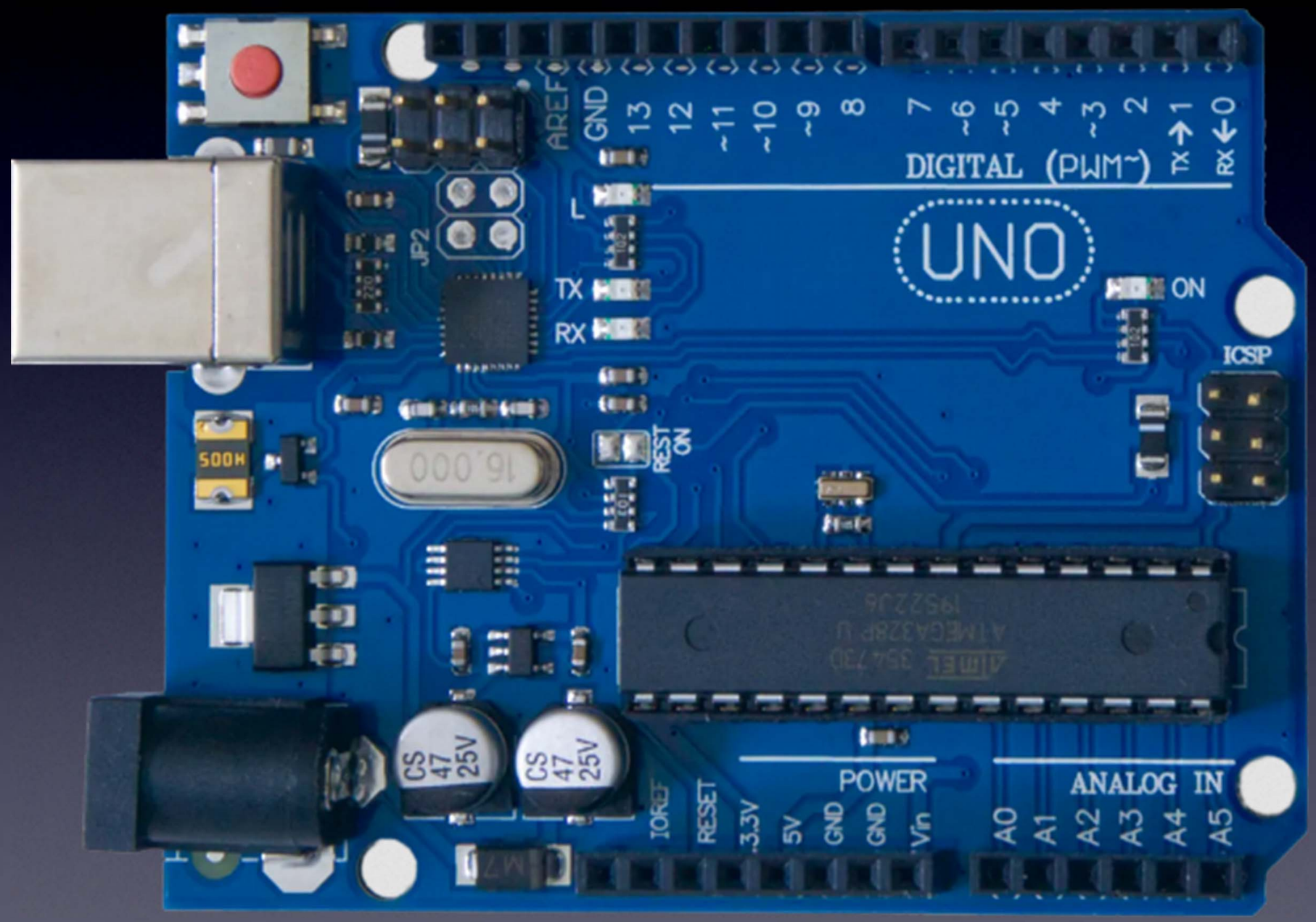
We Won’t Solder Our Own Arduino Clone

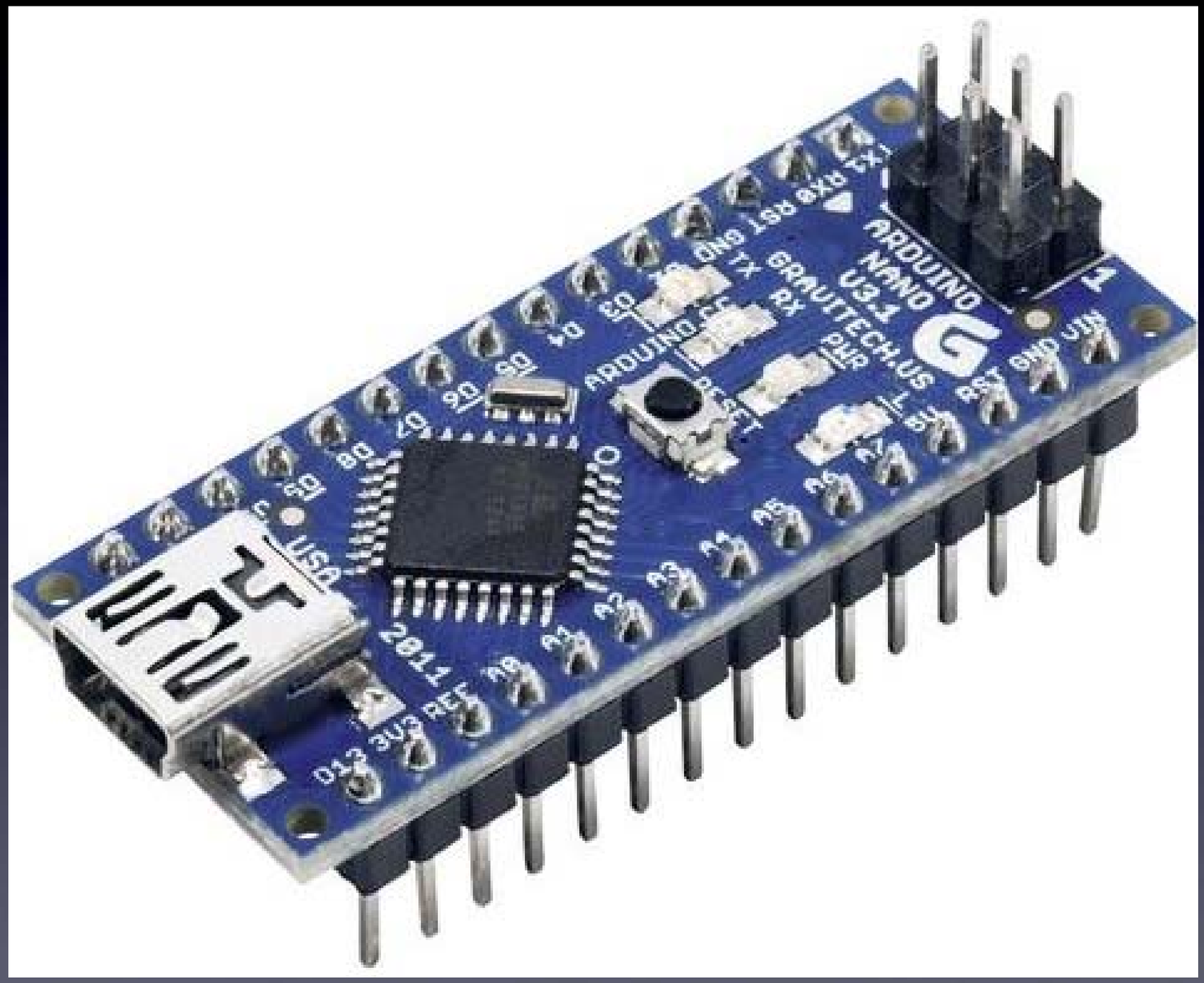


We will use a ready-made Arduino “Clone”



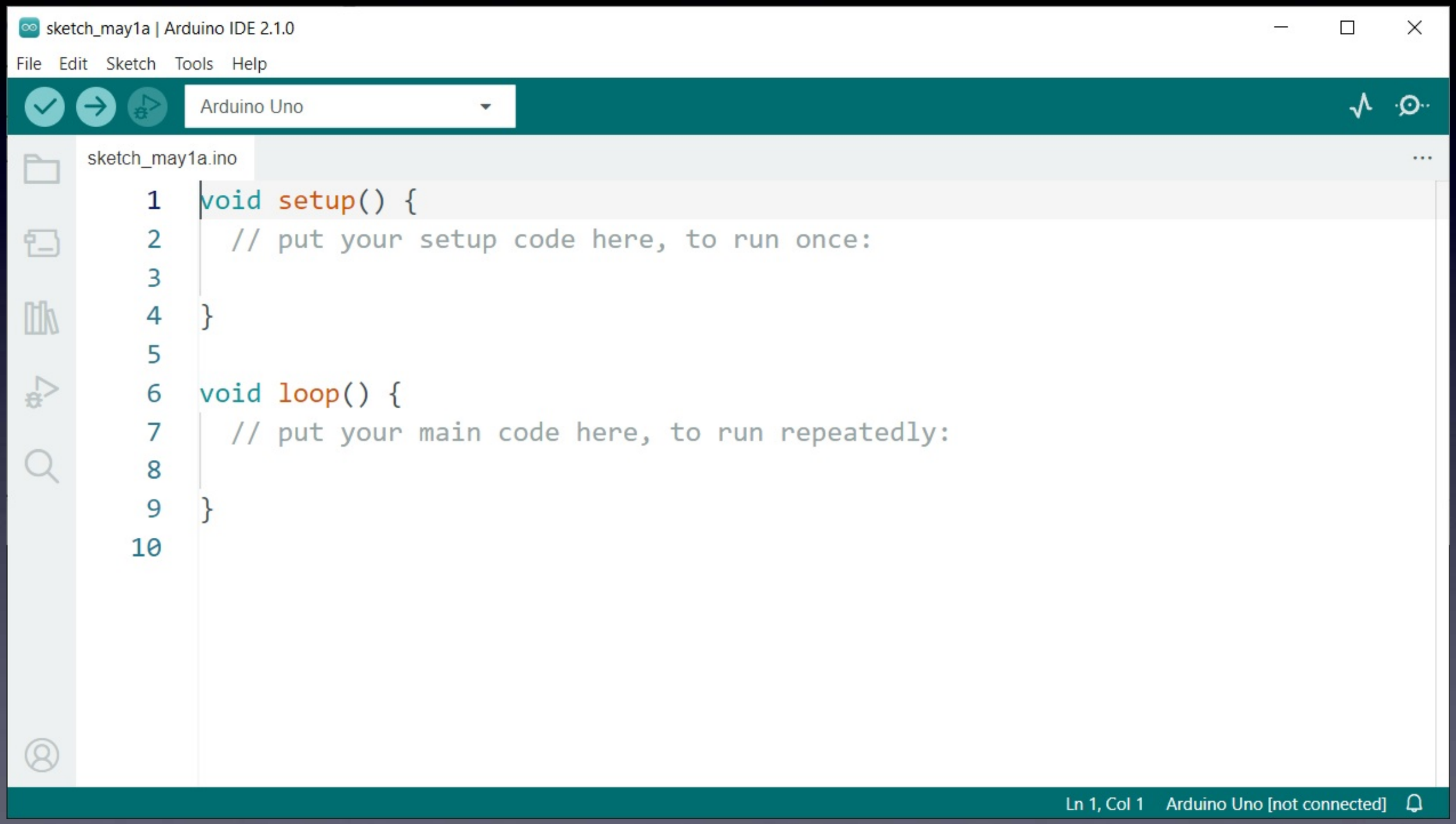
Uno clone

We will use a ready-made Arduino “Clone”



Nano clone

How to Set Up and Use the Arduino Software



How to Hack Arduino Programs (“Sketches”)

Blink | Arduino IDE 2.1.0

File Edit Sketch Tools Help

Arduino Uno

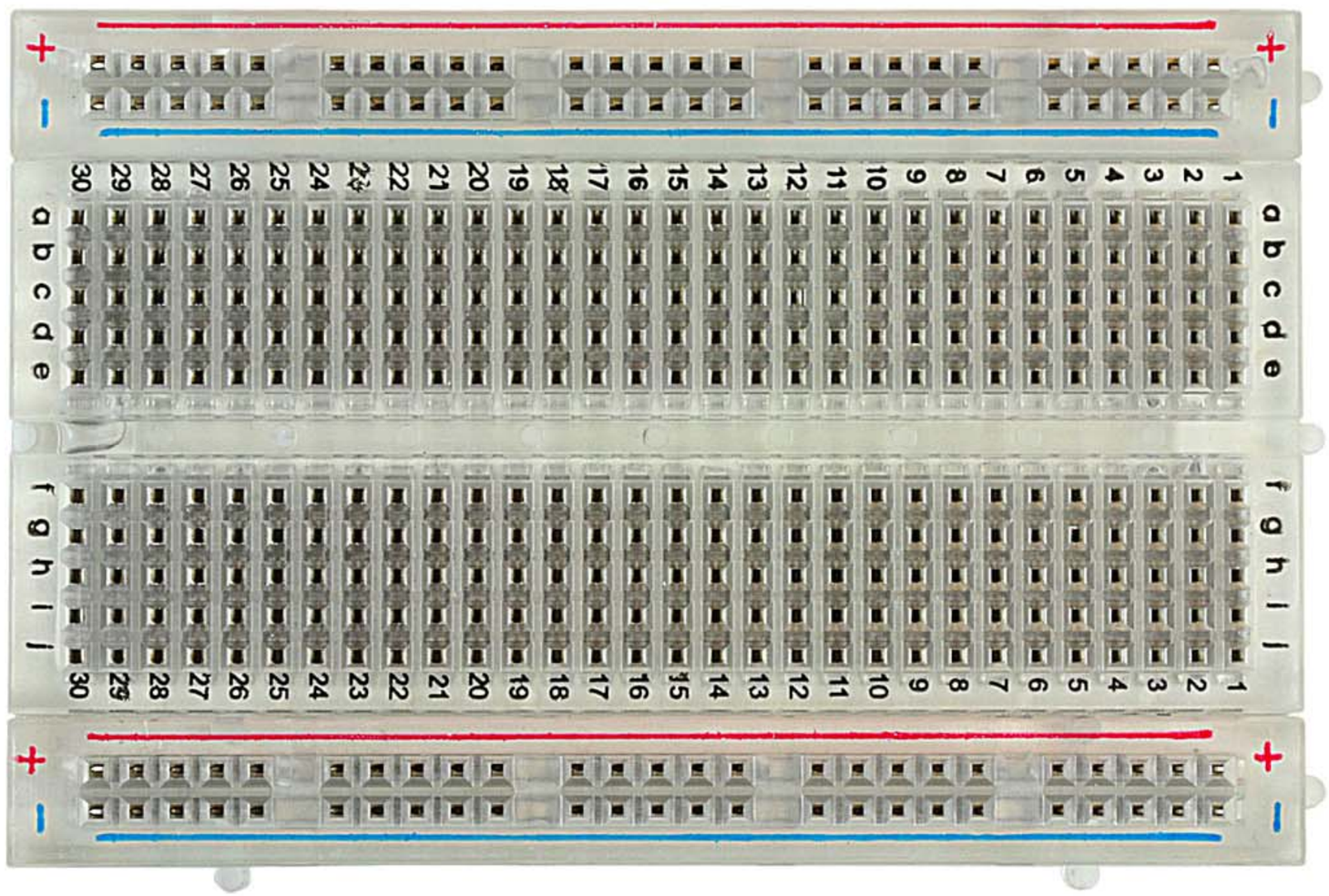
Blink.ino

```
/*
  Blink

  Turns an LED on for one second, then off for one second, repeatedly.

  Most Arduinos have an on-board LED you can control. On the UNO, MEGA and ZERO
  it is attached to digital pin 13, on MKR1000 on pin 6. LED_BUILTIN is set to
  the correct LED pin independent of which board is used.
  If you want to know what pin the on-board LED is connected to on your Arduino
  model, check the Technical Specs of your board at:
  https://www.arduino.cc/en/Main/Products

  modified 8 May 2014
  by Scott Fitzgerald
  modified 2 Sep 2016
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink
*/

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000);                      // wait for a second
  digitalWrite(LED_BUILTIN, LOW);   // turn the LED off by making the voltage LOW
  delay(1000);                      // wait for a second
}
```

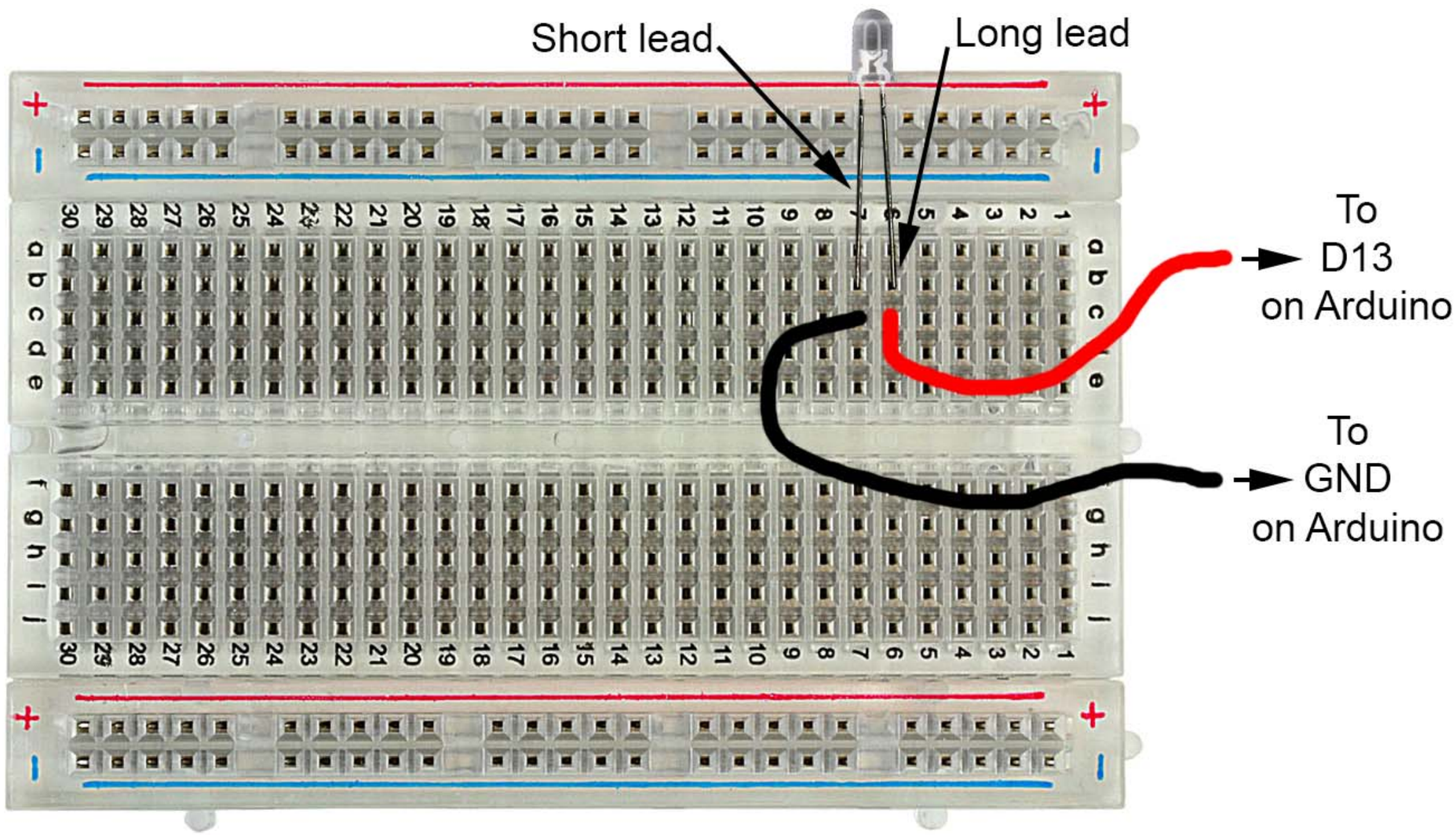
Ln 1, Col 1 Arduino Uno [not connected]

How to Use Solderless Breadboards

Solderless Breadboard



How to Use Solderless Breadboards

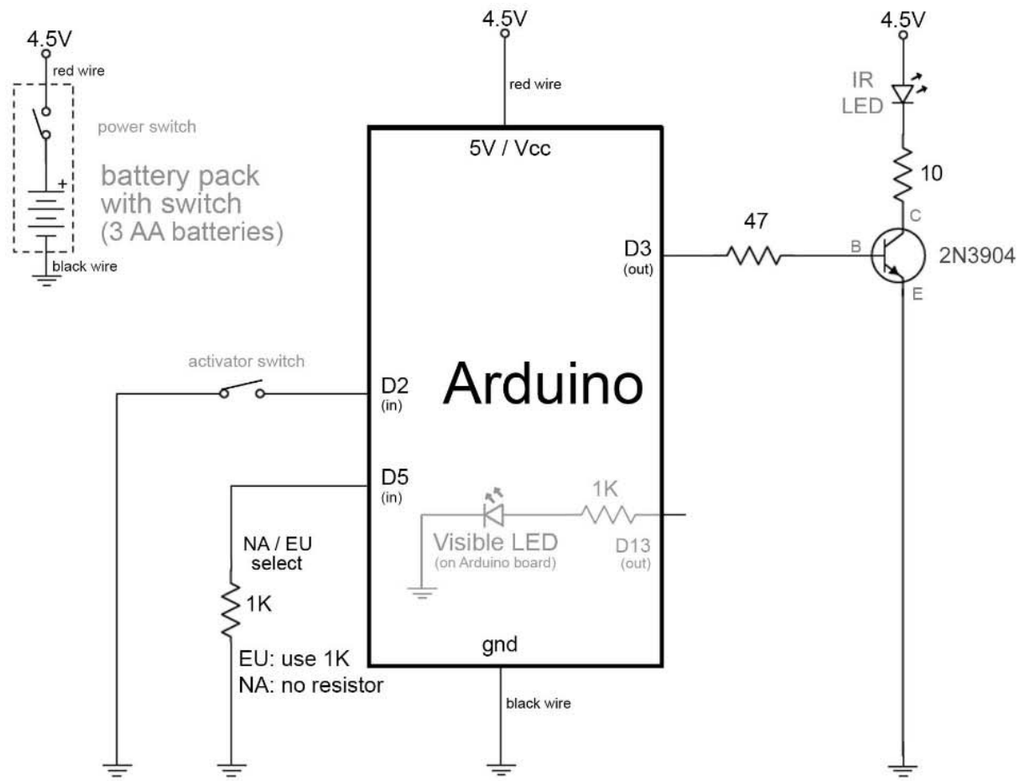


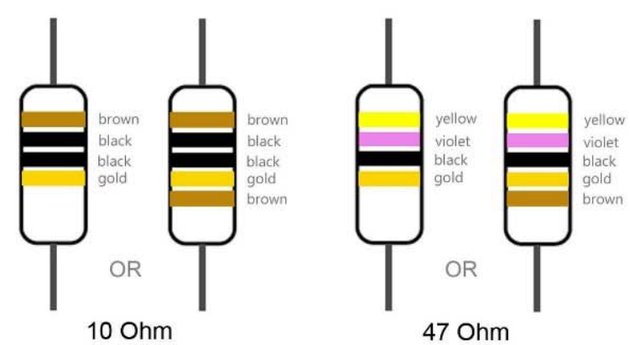
How to Read a Schematic

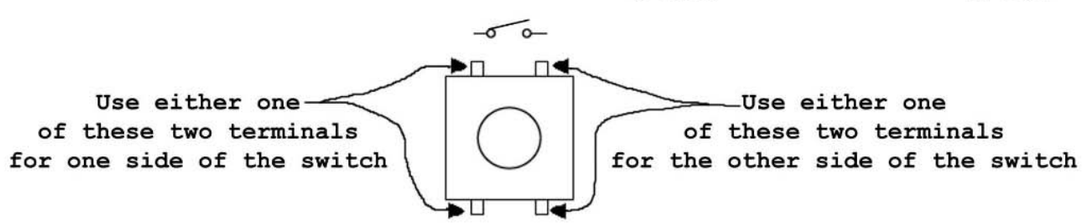
Arduino For Total Newbies

4-Sep-2015

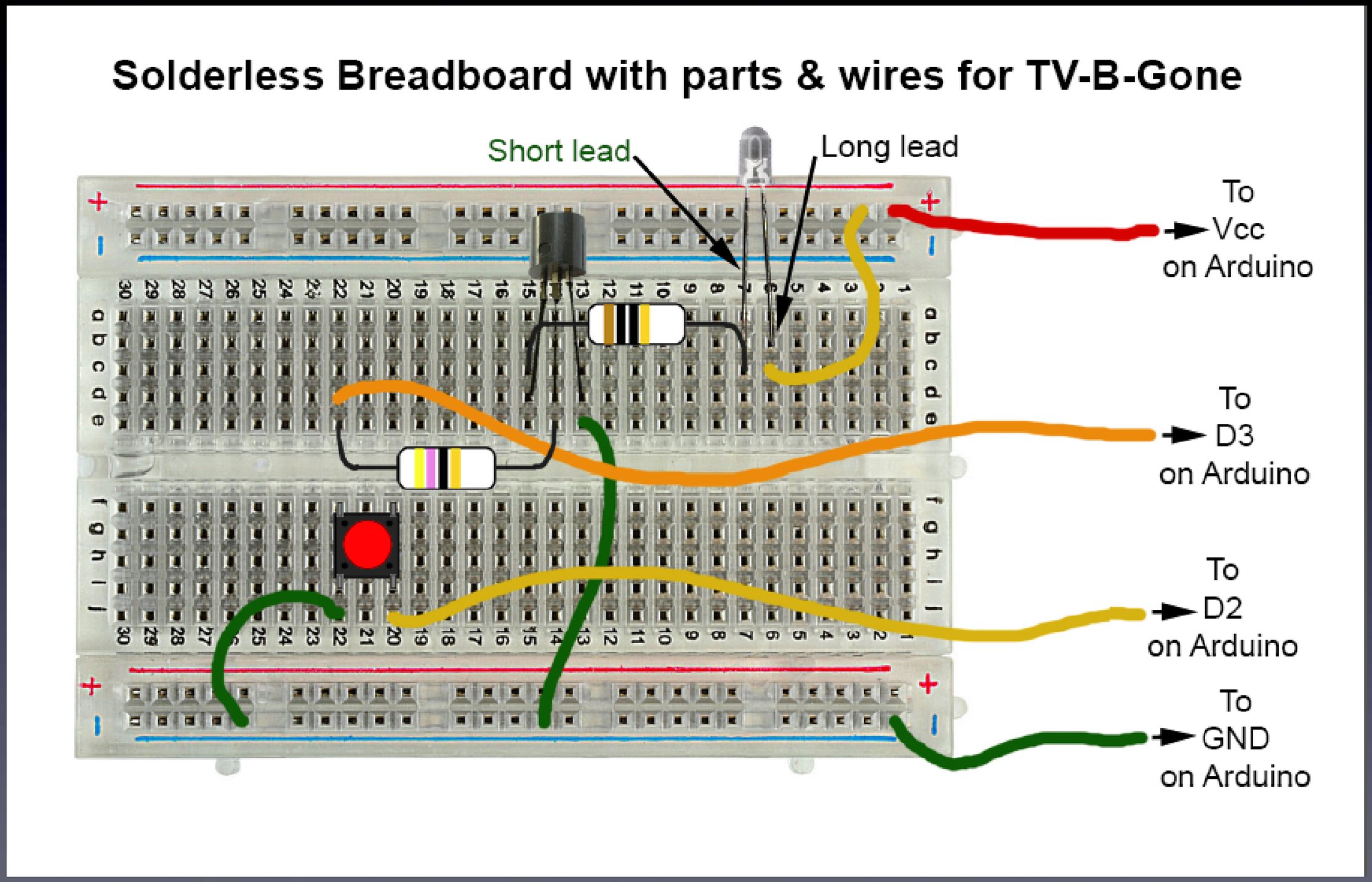
Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limore Fried (firmware modifications, kit design)
Ken Shirriff (original modifications for Arduino)
Johannes Schneemann (documentation)

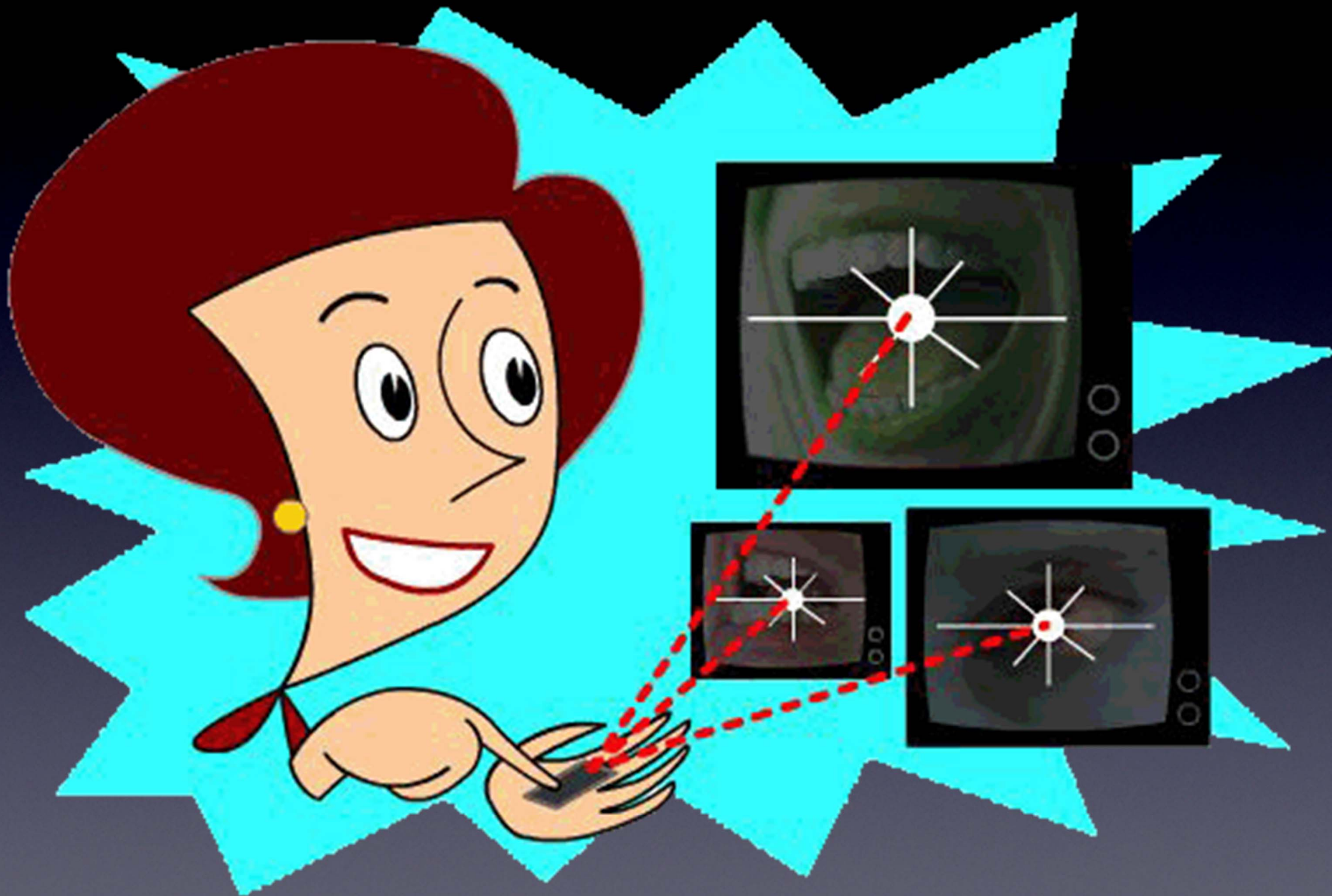






Make a TV-B-Gone Remote Control with your Arduino Clone without soldering





Questions?

Intro

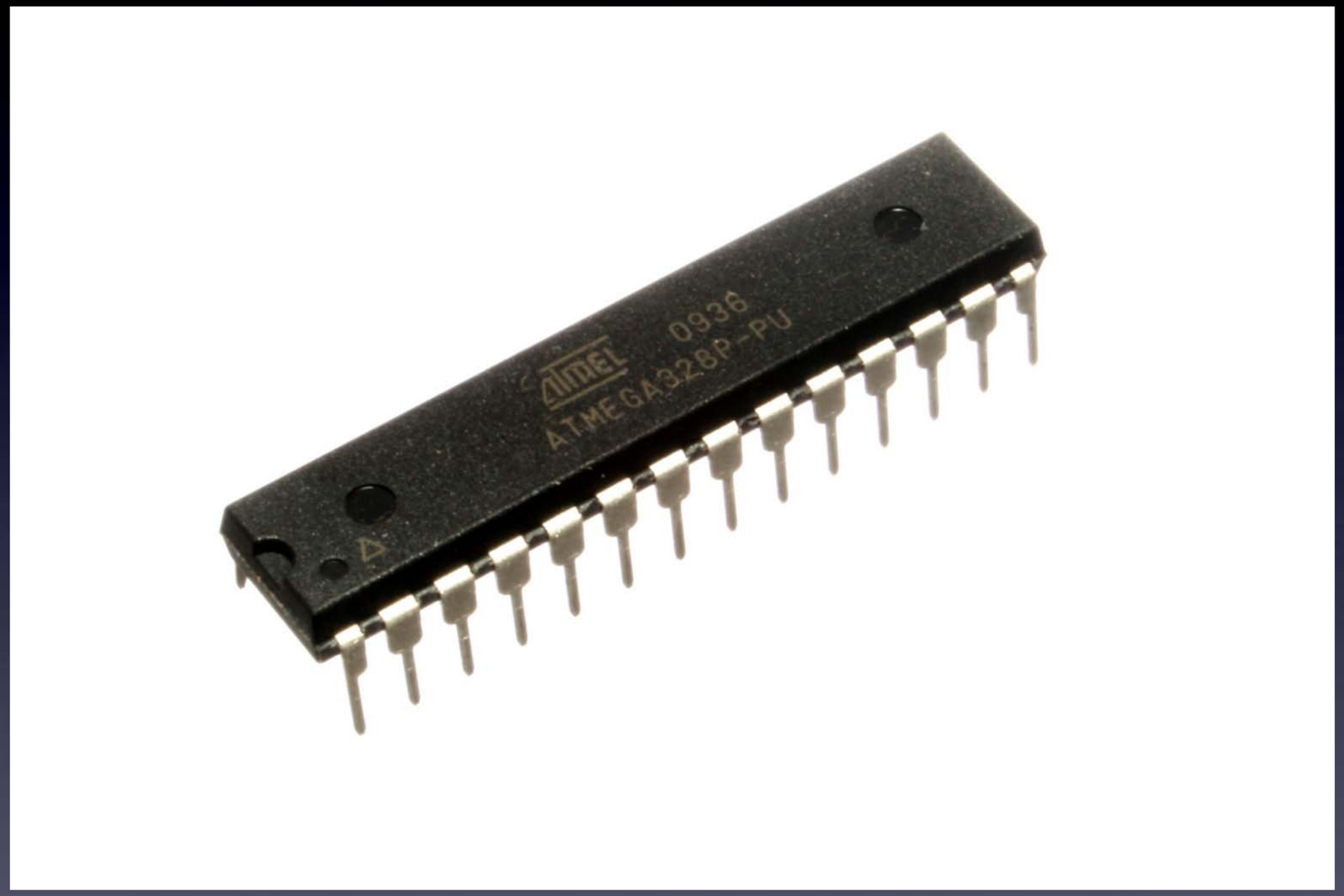
Noisebridge Hacker Space
https://noisebridge.net
2169.mission.sf.ca.us

Intro

Arduino For Total Newbies Workshop at 30C3, Hamburg Germany

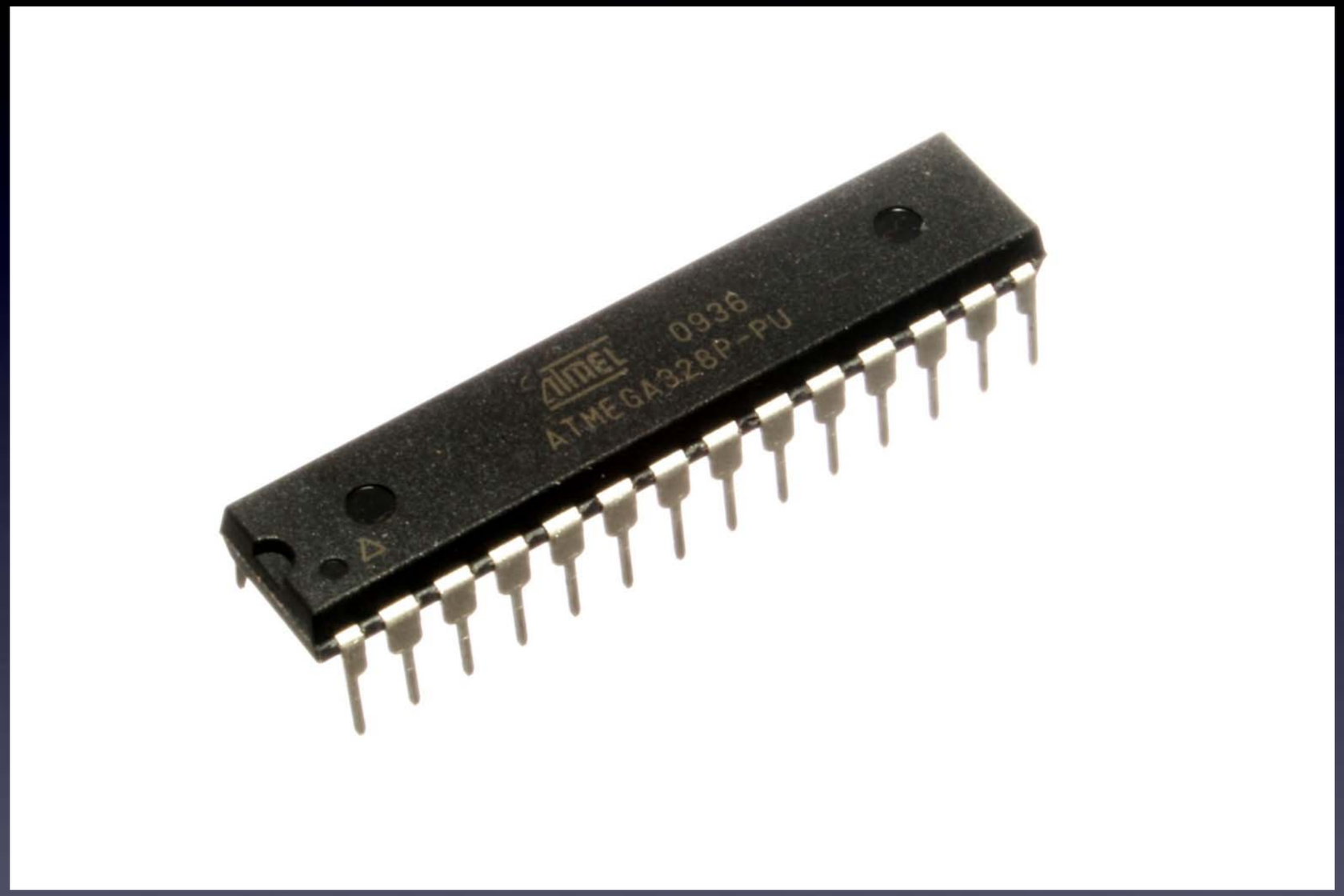
Intro to Arduino

Intro to Arduino: microcontrollers



A complete computer on a chip

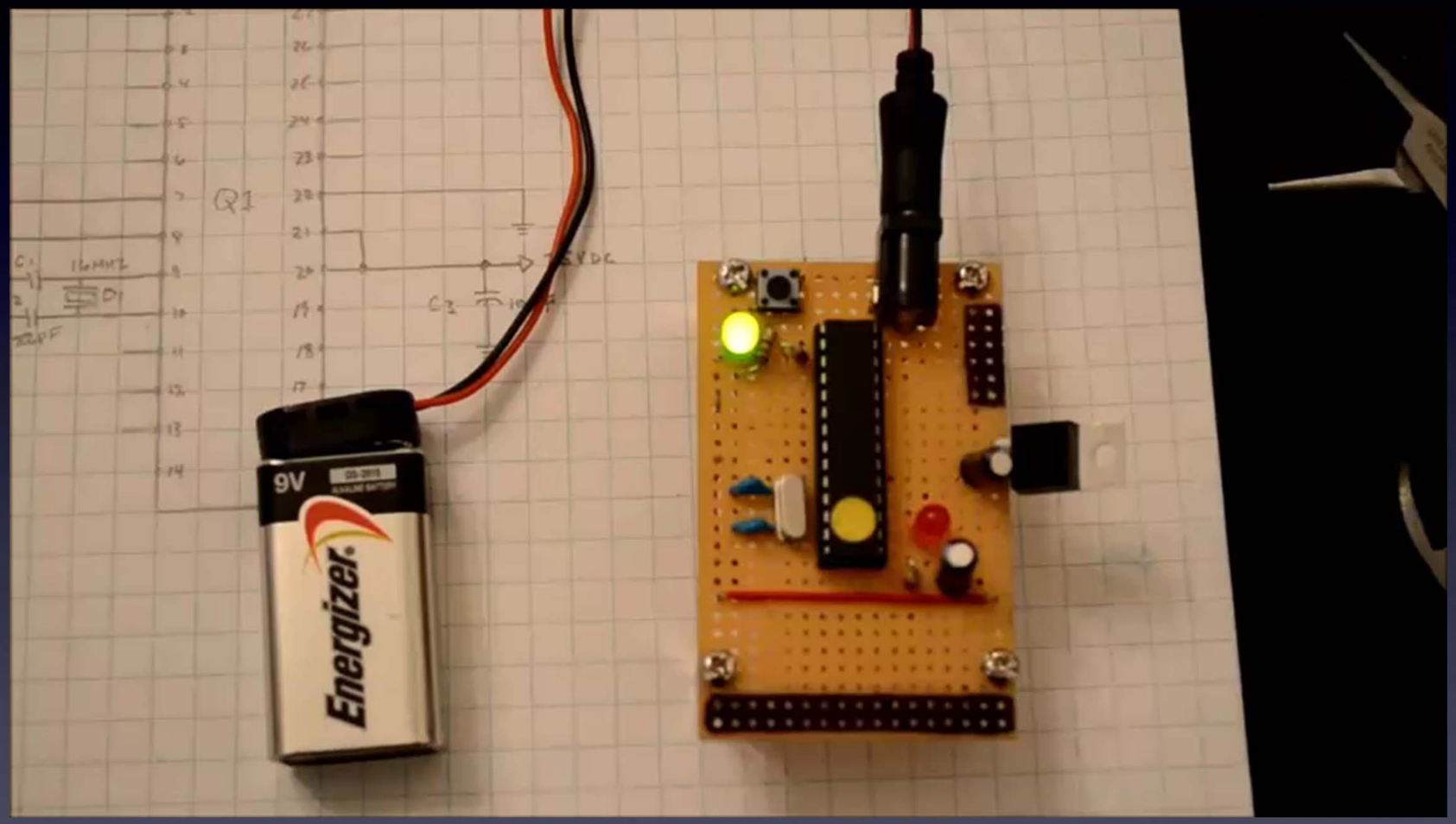
Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

Intro to Arduino: microcontrollers



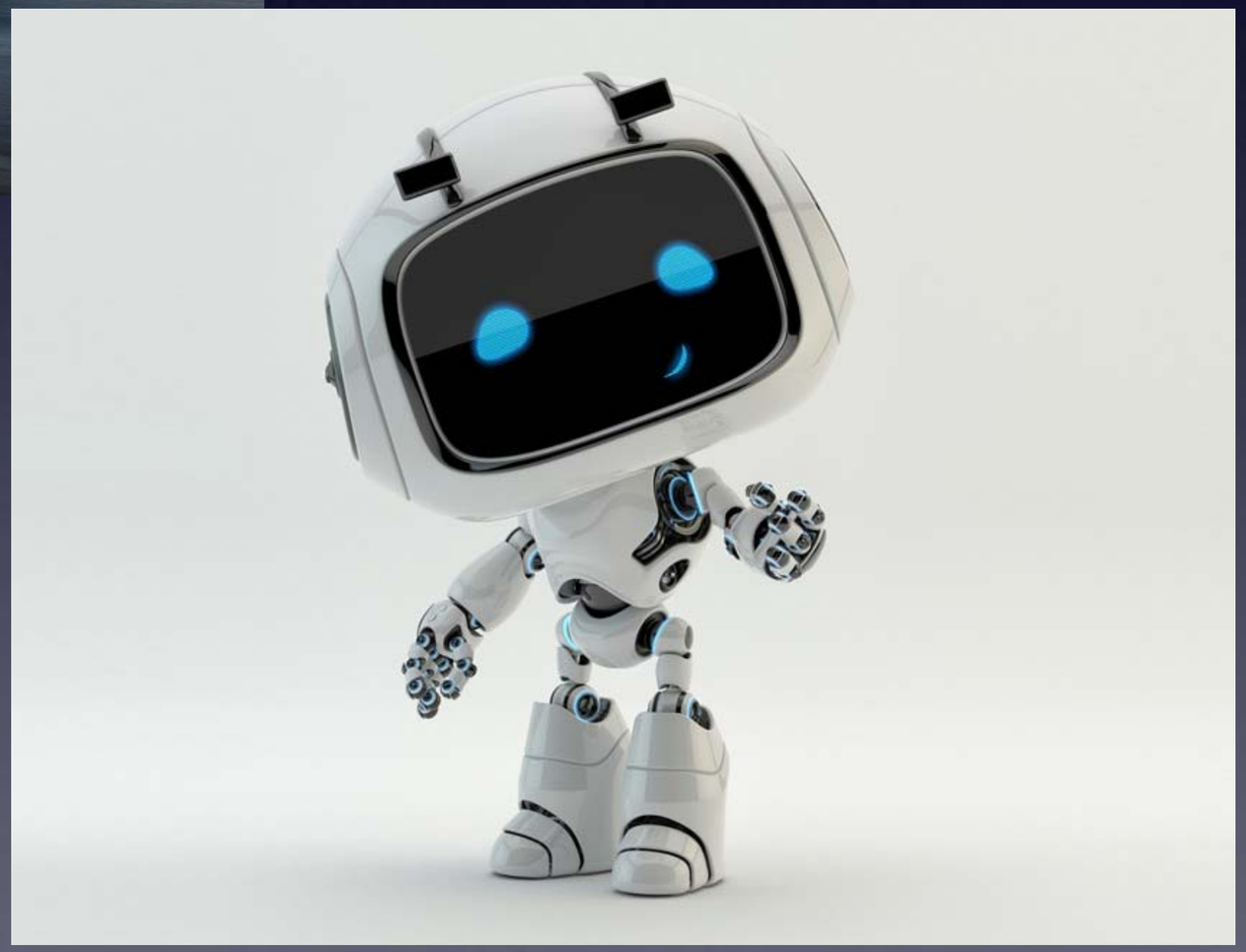
Intro to Arduino: microcontrollers

-- one of Mitch's projects --

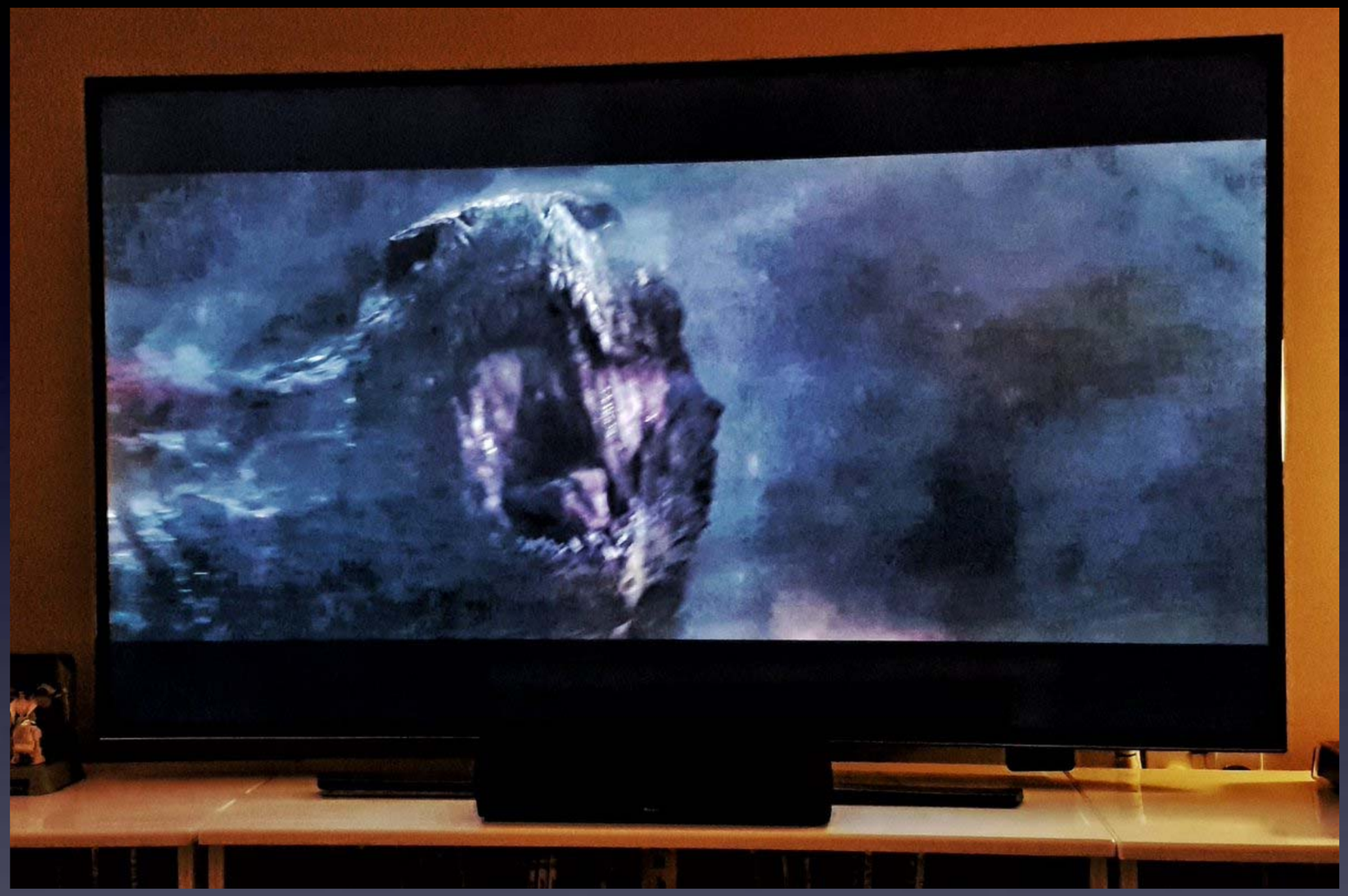
ArduTouch music synthesizer *kit*

Intro to Arduino: microcontrollers

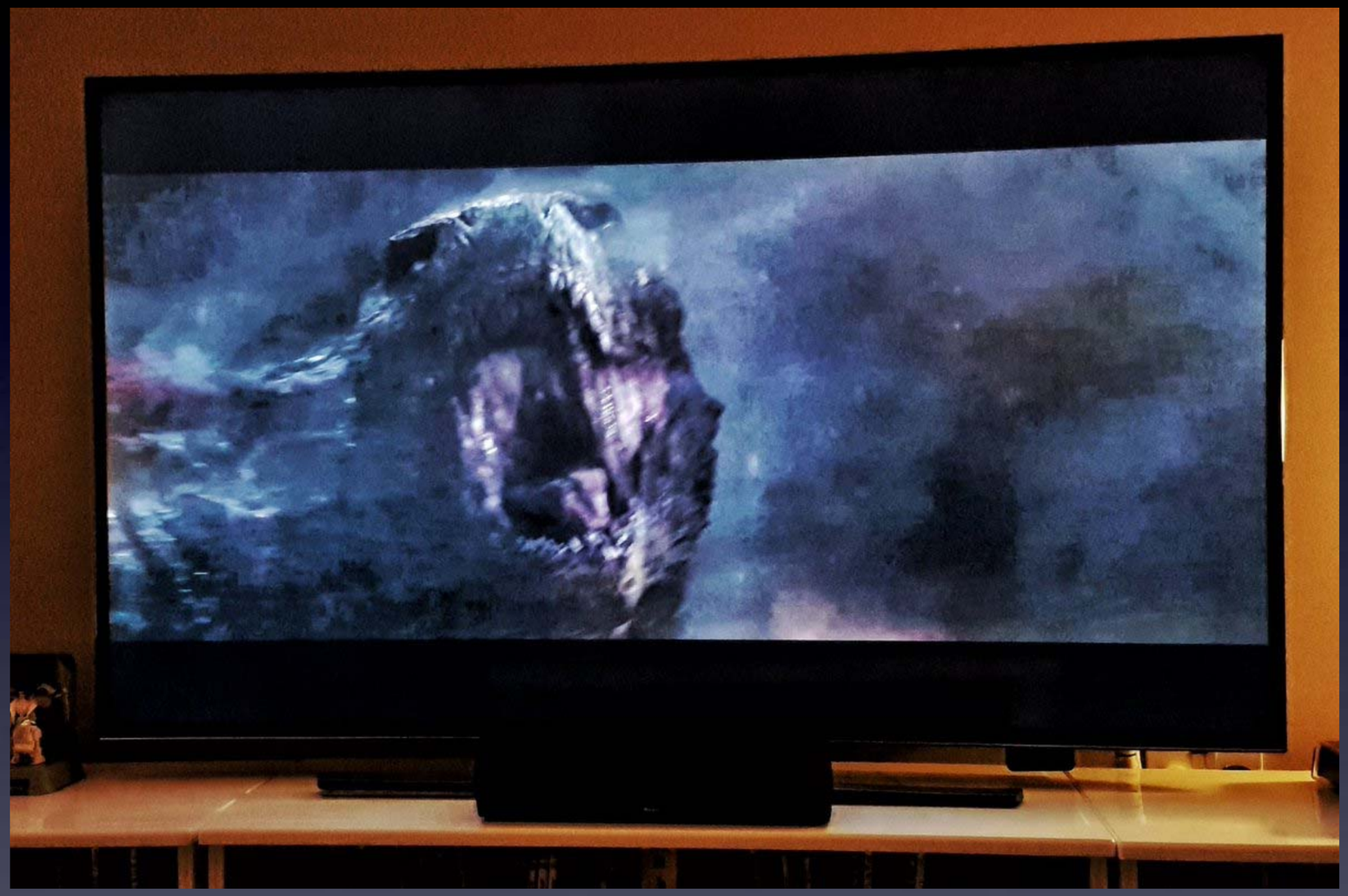
Intro to Arduino: microcontrollers



Intro to Arduino: microcontrollers



Intro to Arduino: microcontrollers



Intro to Arduino: microcontrollers

-- one of Mitch's projects --

TV-B-Gone

Intro to Arduino: microcontrollers

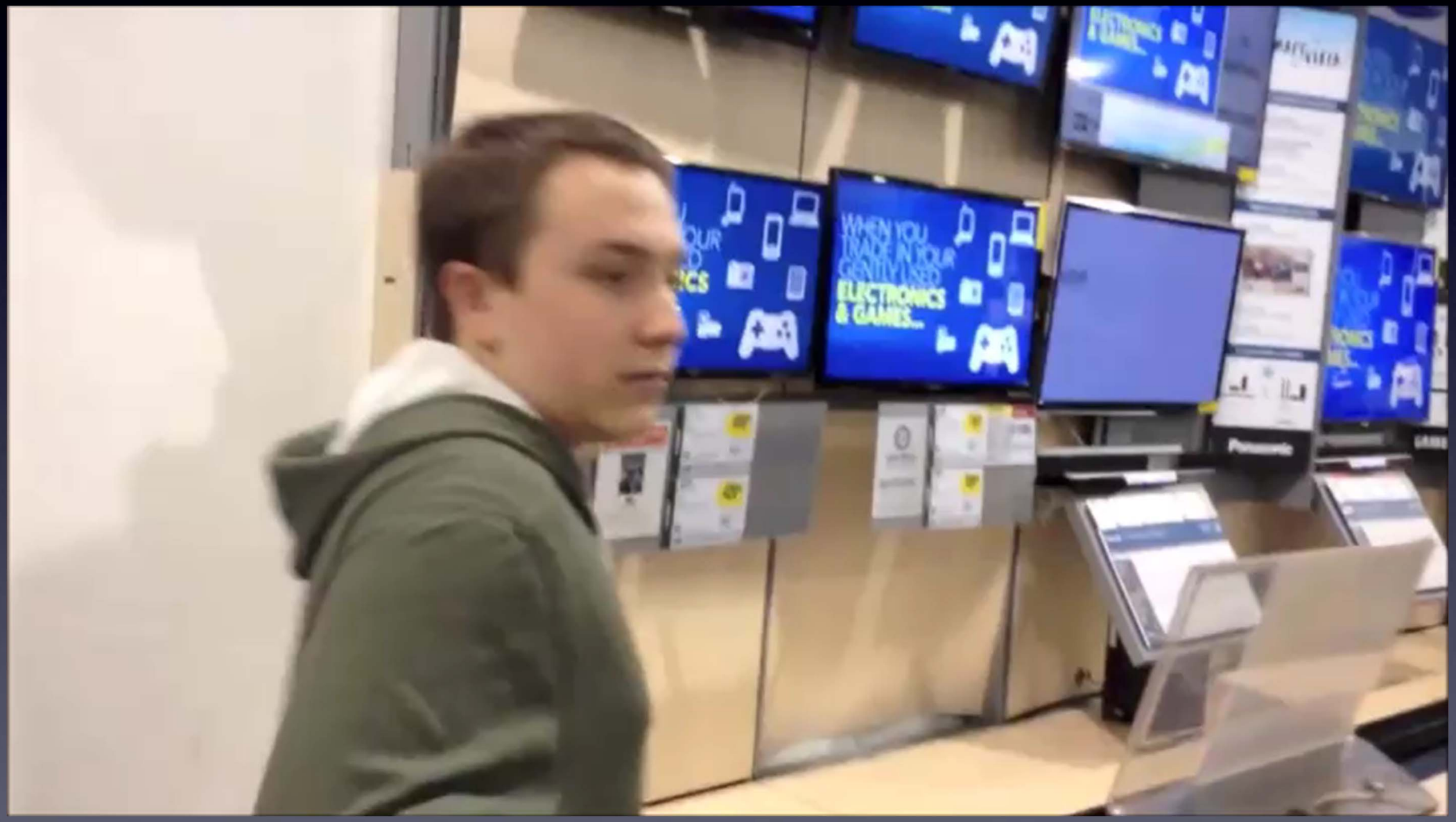
-- one of Mitch's projects --

TV-B-Gone

Just a remote control, but only one button: OFF !

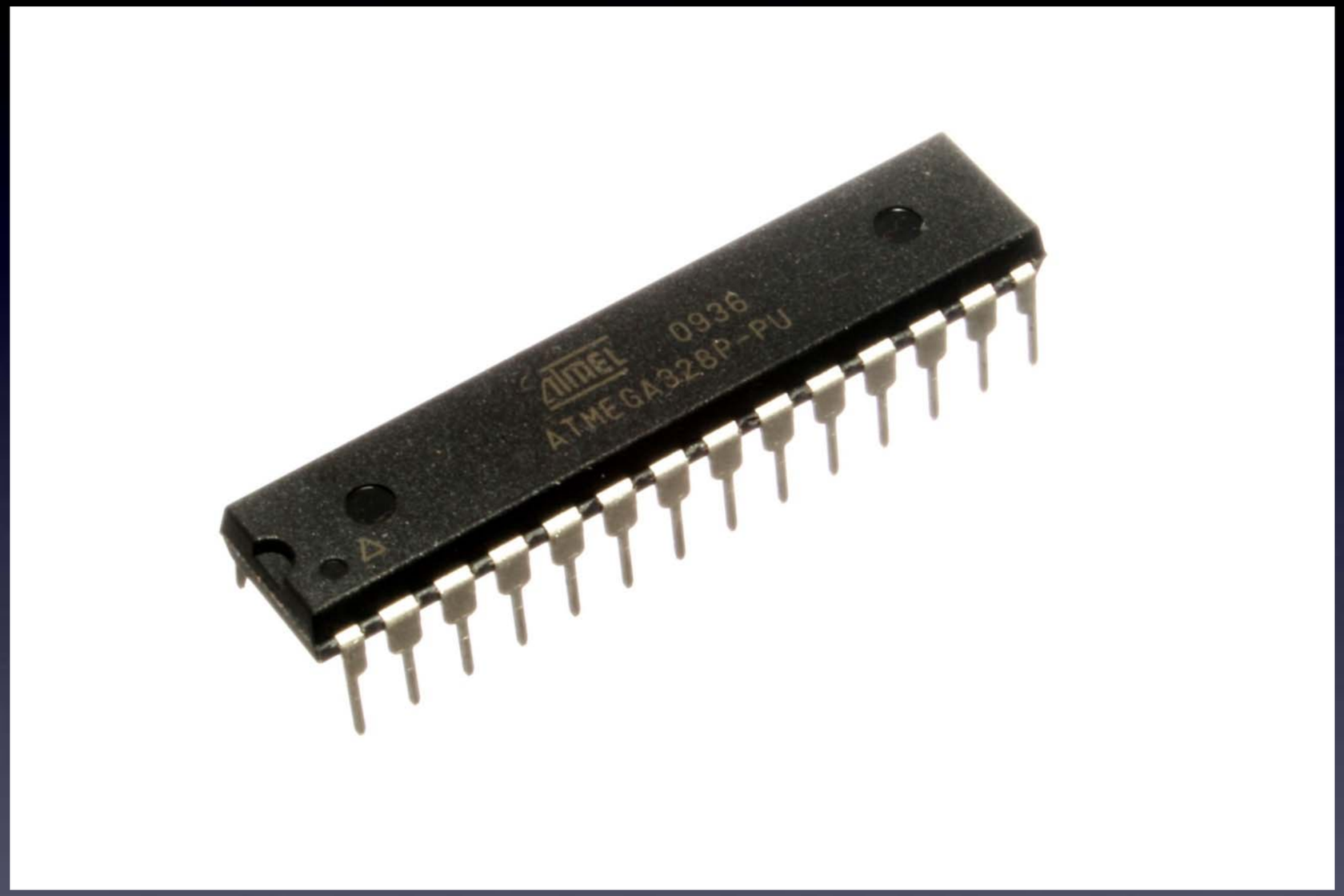
Intro to Arduino: microcontrollers

-- one of Mitch's projects --



TV-B-Gone

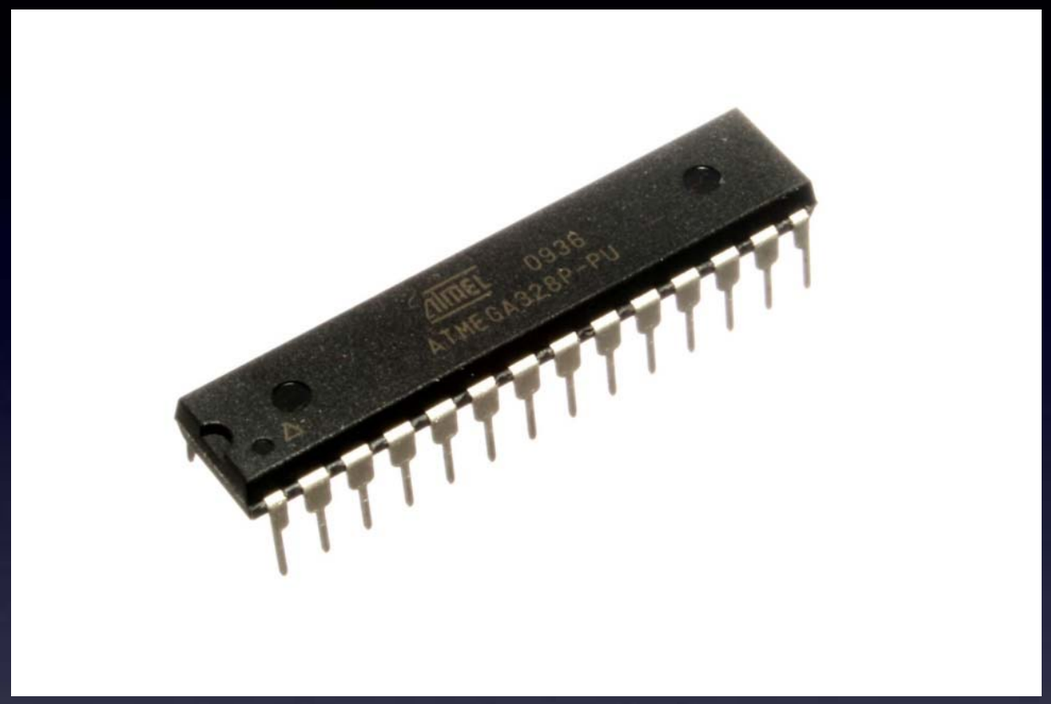
Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

Intro to Arduino: microcontrollers



A complete computer on a chip:

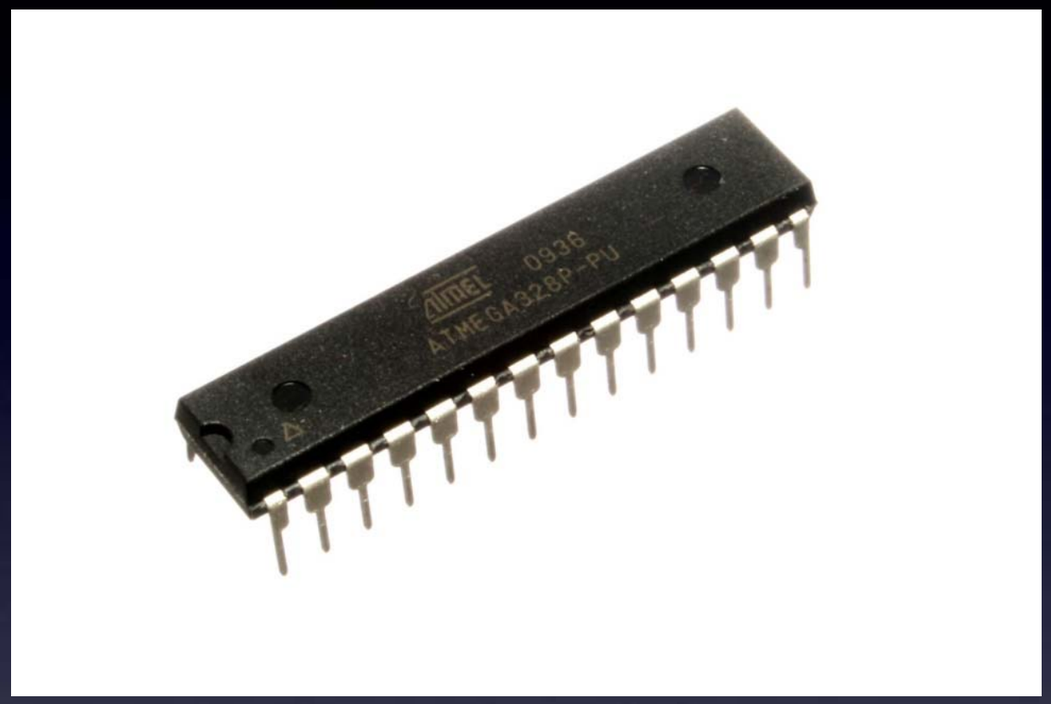
they control parts connected to their pins

But,

How do you
connect parts to its pins?

How do you
create and upload a program
to control the parts?

Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

But,

How do you
connect parts to its pins?

How do you
create and upload a program
to control the parts?

Answer: Be a geek, and learn how!

Or

Intro to Arduino

Use an Arduino board

Intro to Arduino

Super easy to connect parts to its microcontroller's pins

Use an Arduino board

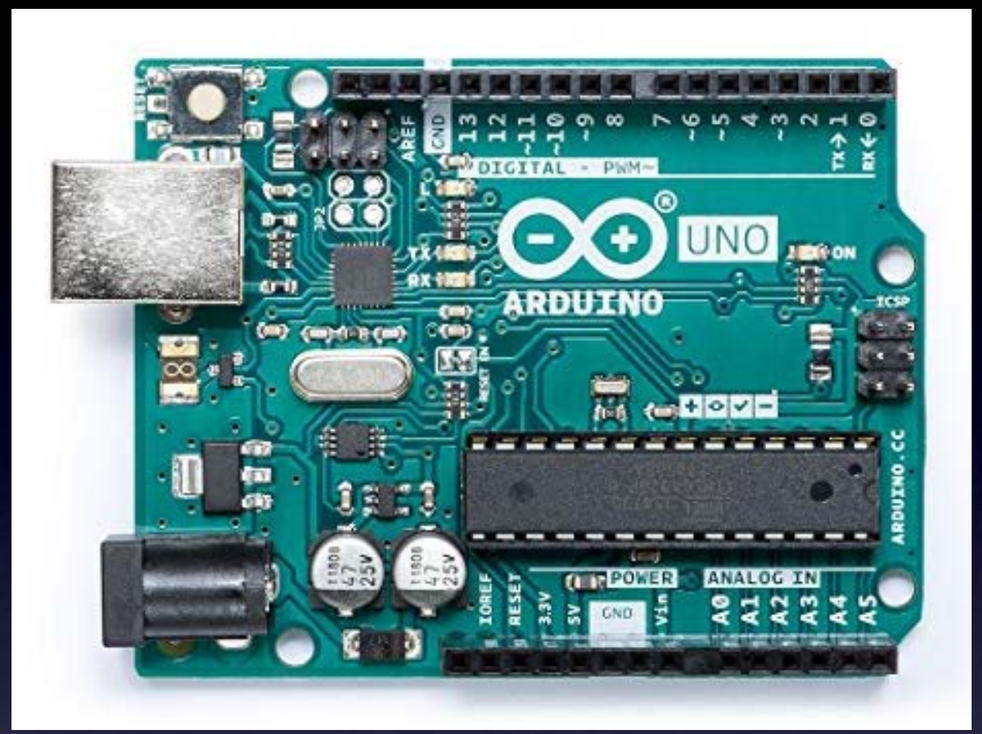
Intro to Arduino

Use an Arduino board

Super easy to
connect parts
to its microcontroller's pins

Super easy to
create and upload a program
to control the parts

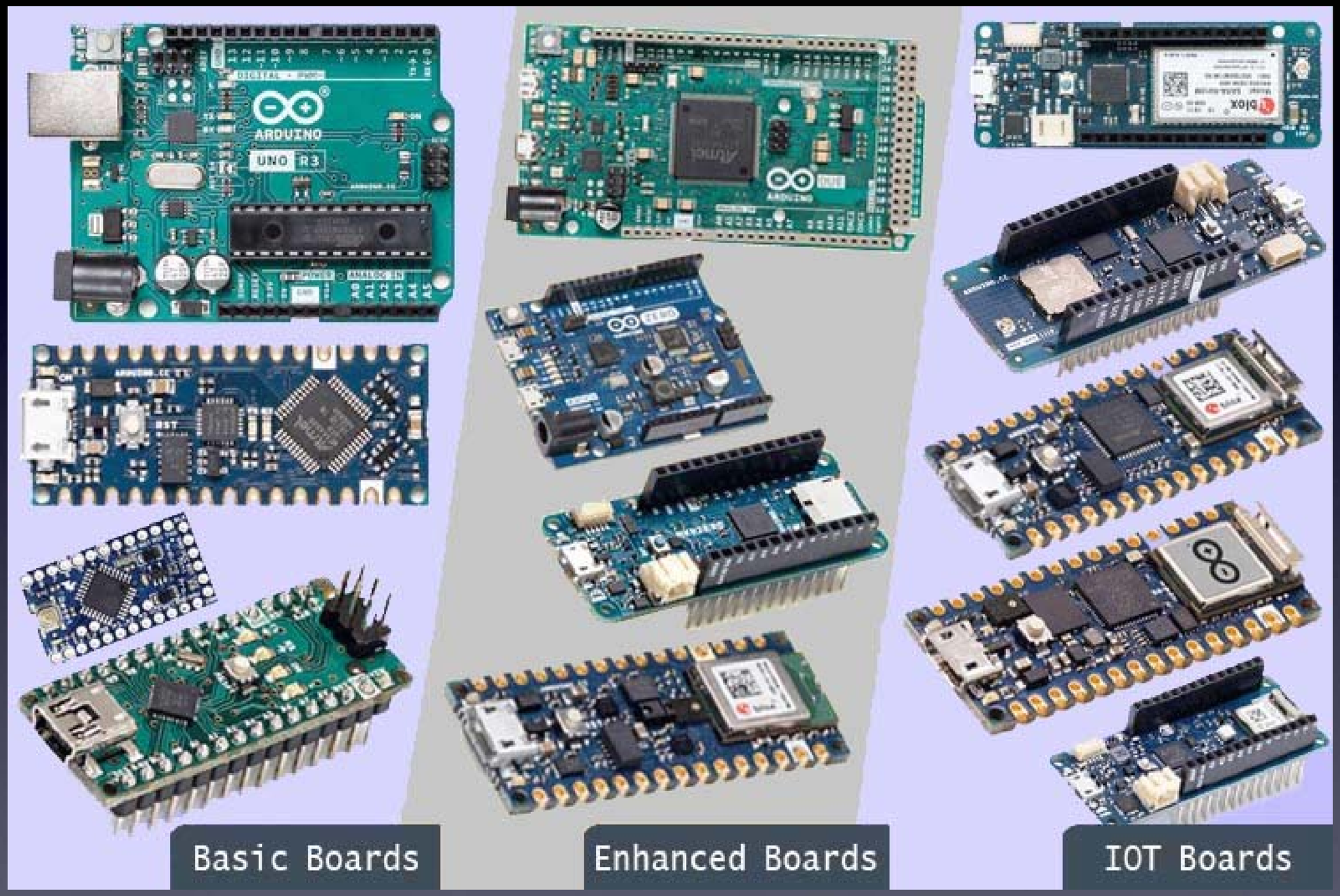
Intro to Arduino



Arduino board

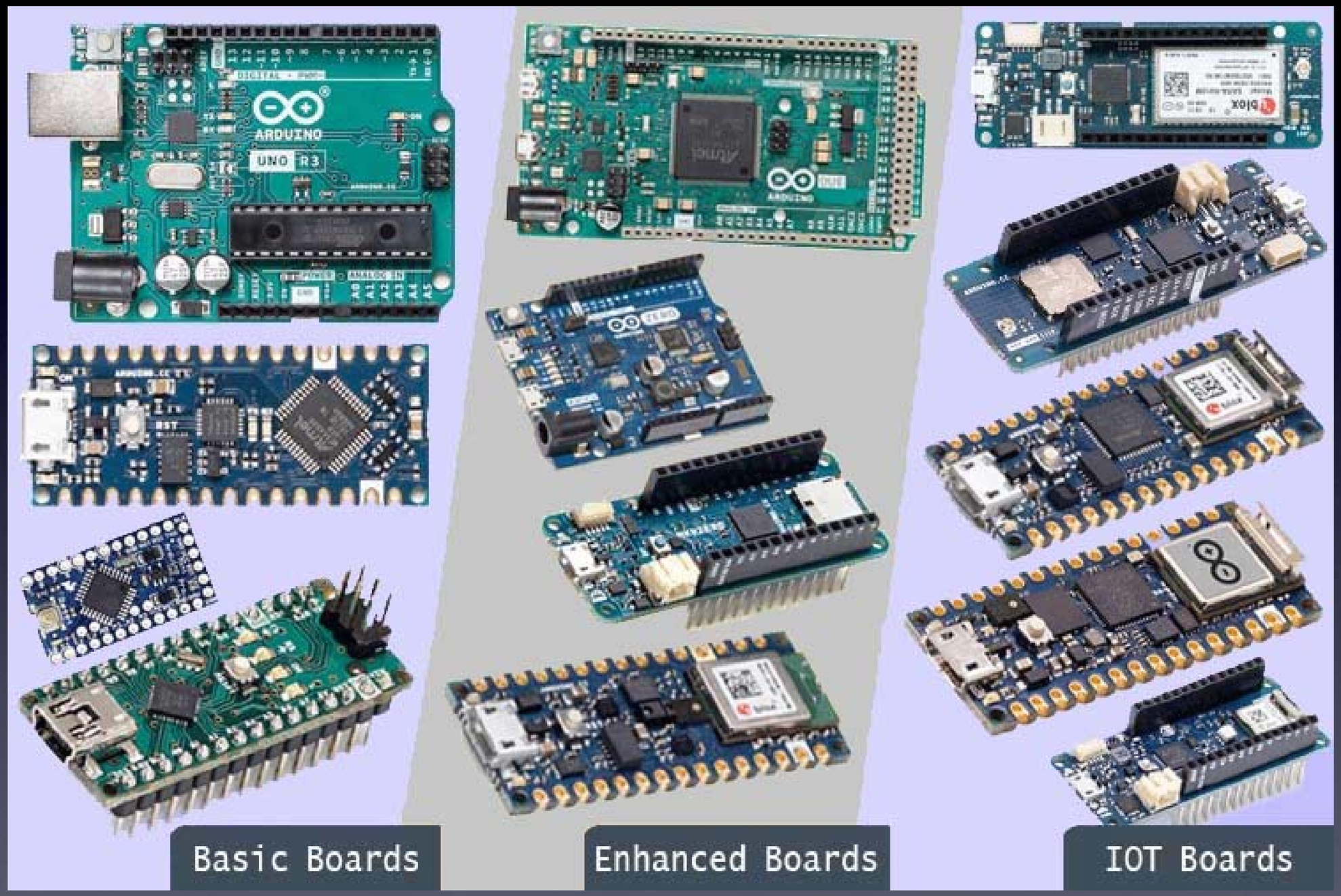
Designed for non-geeky artists

Intro to Arduino



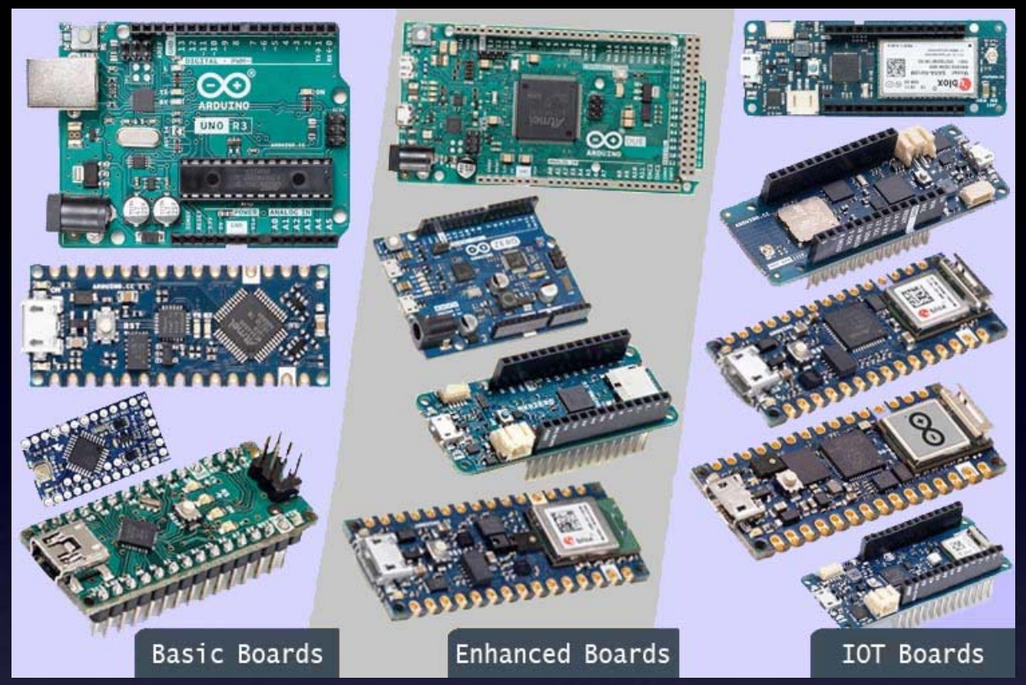
Many Arduino boards to choose from

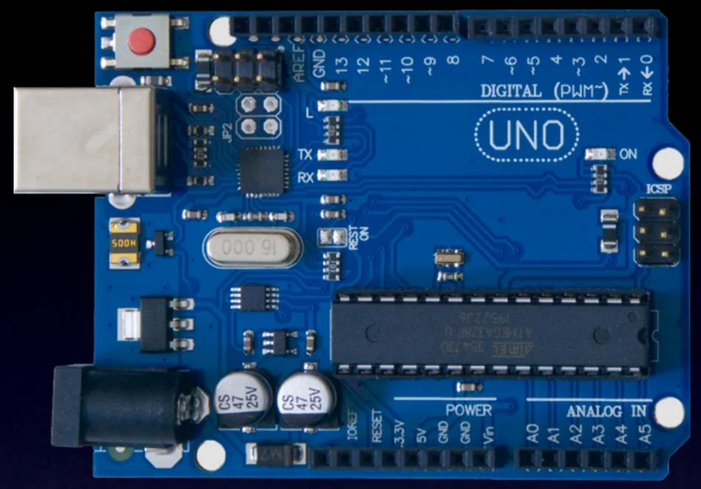
Intro to Arduino

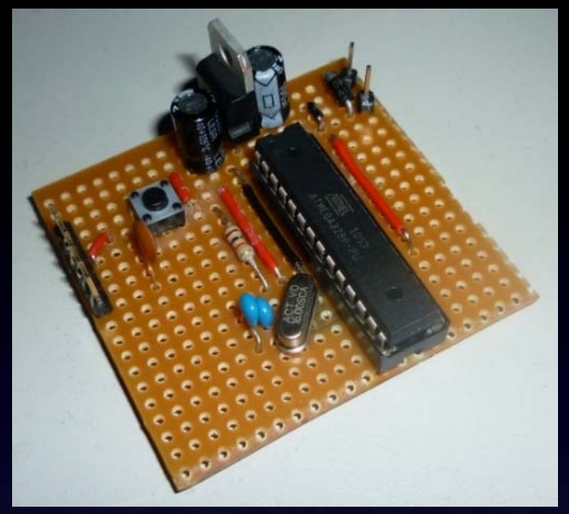


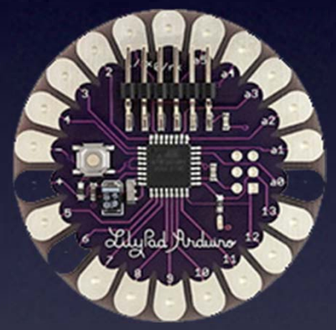
Open Source

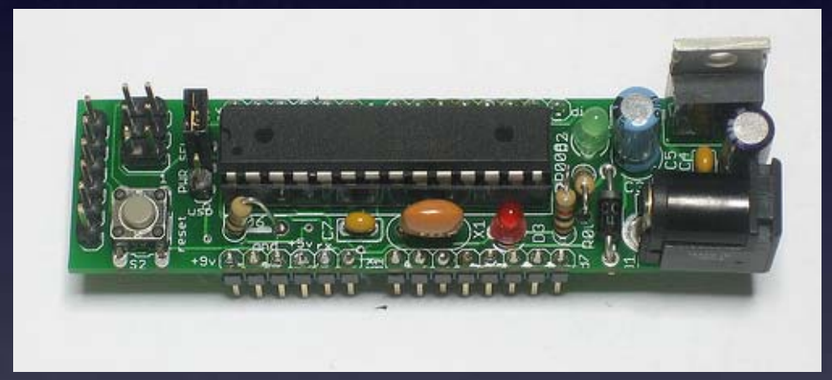
Intro to Arduino

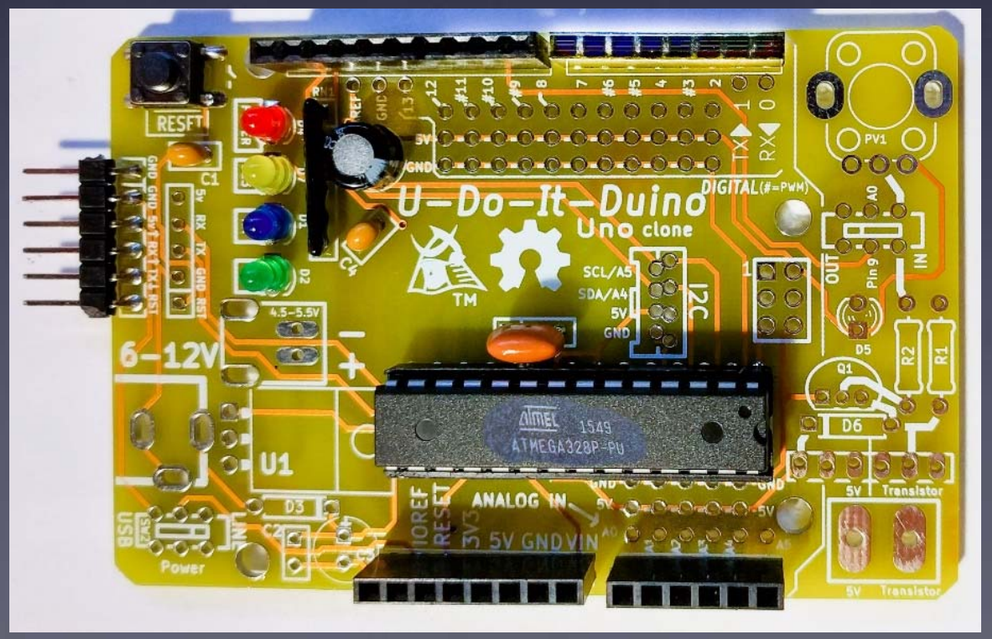


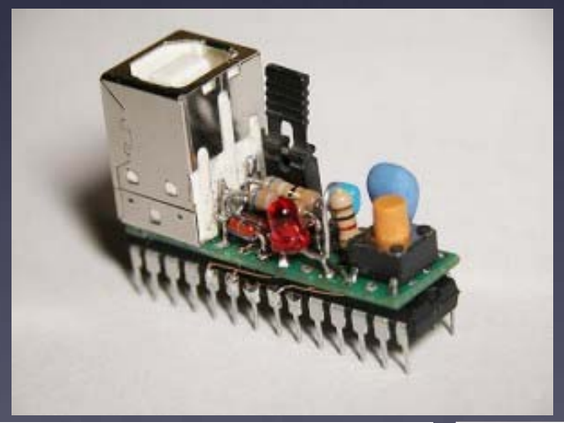


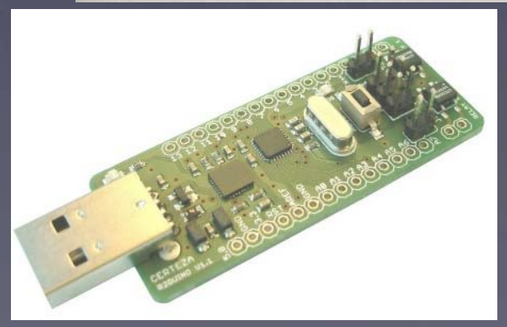








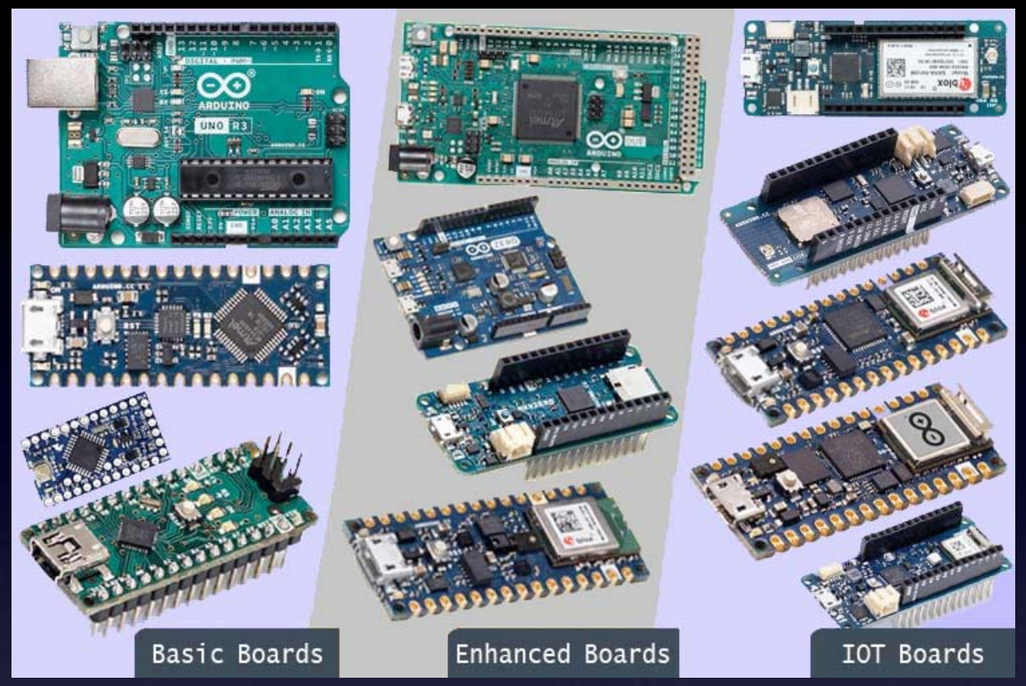


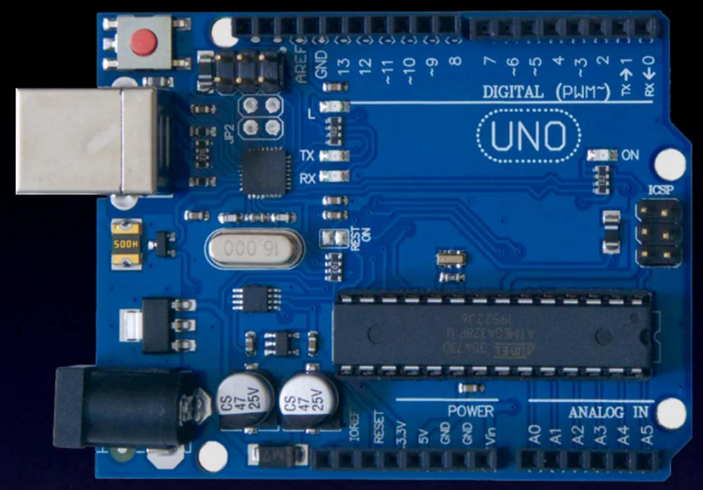


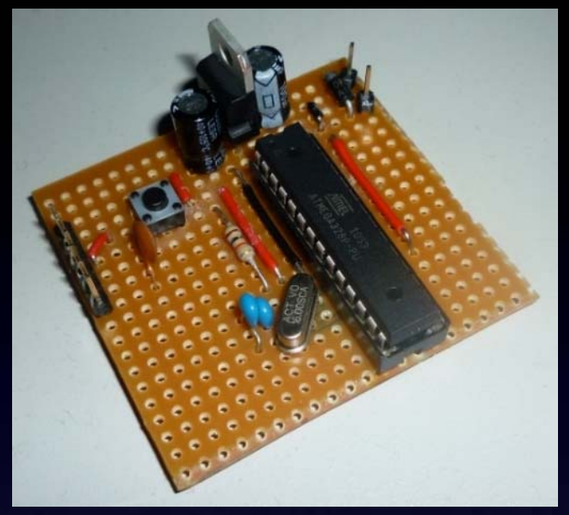
open hardware

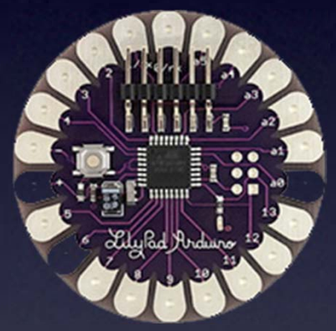
Open Source

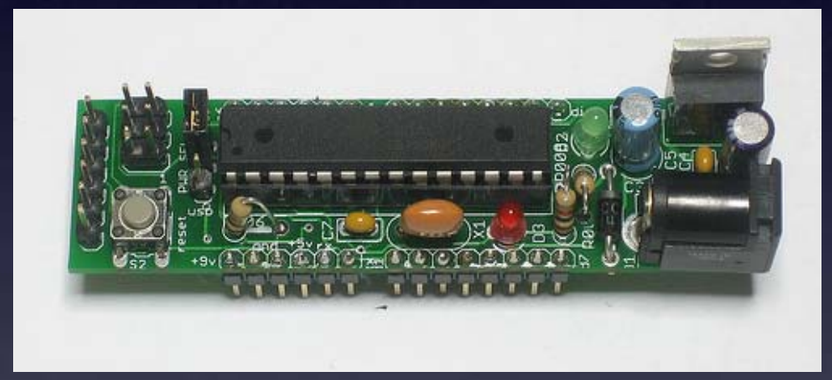
Intro to Arduino

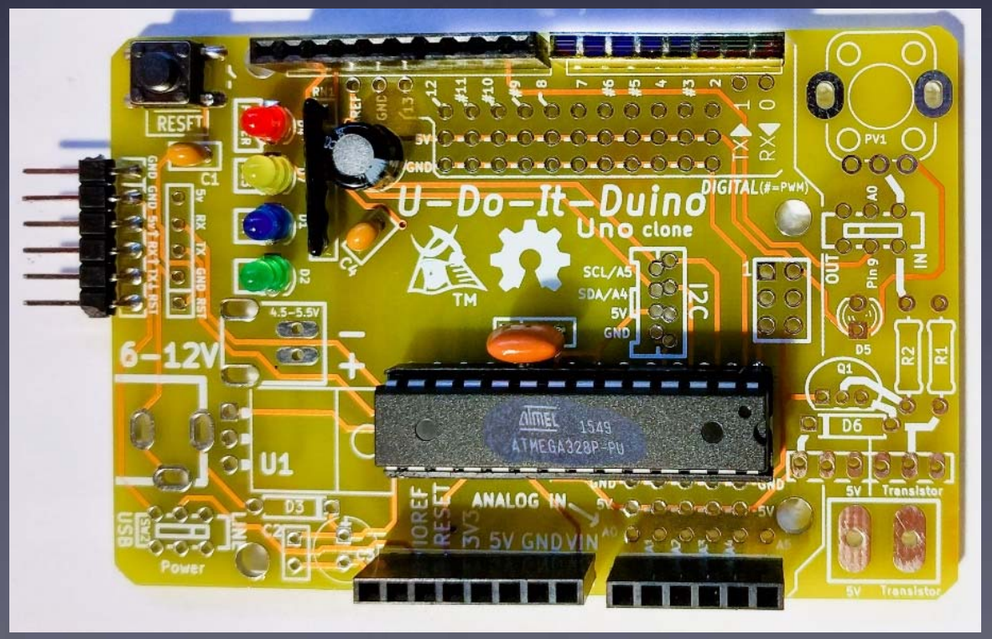


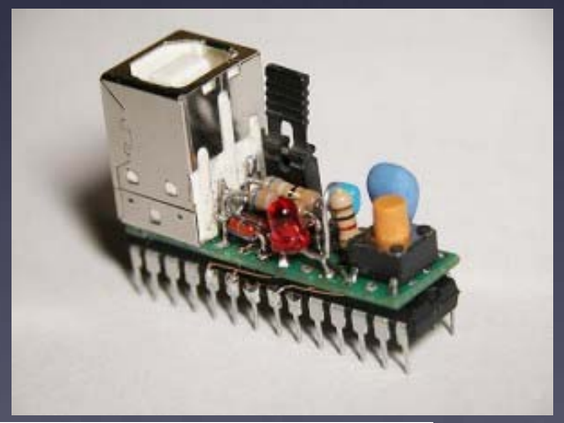


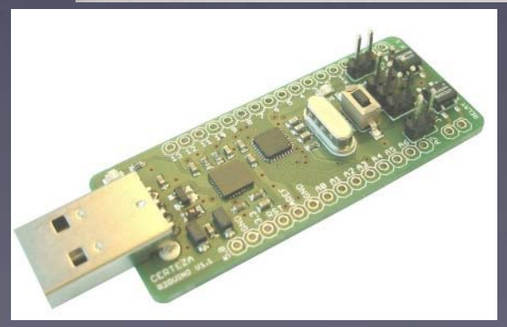






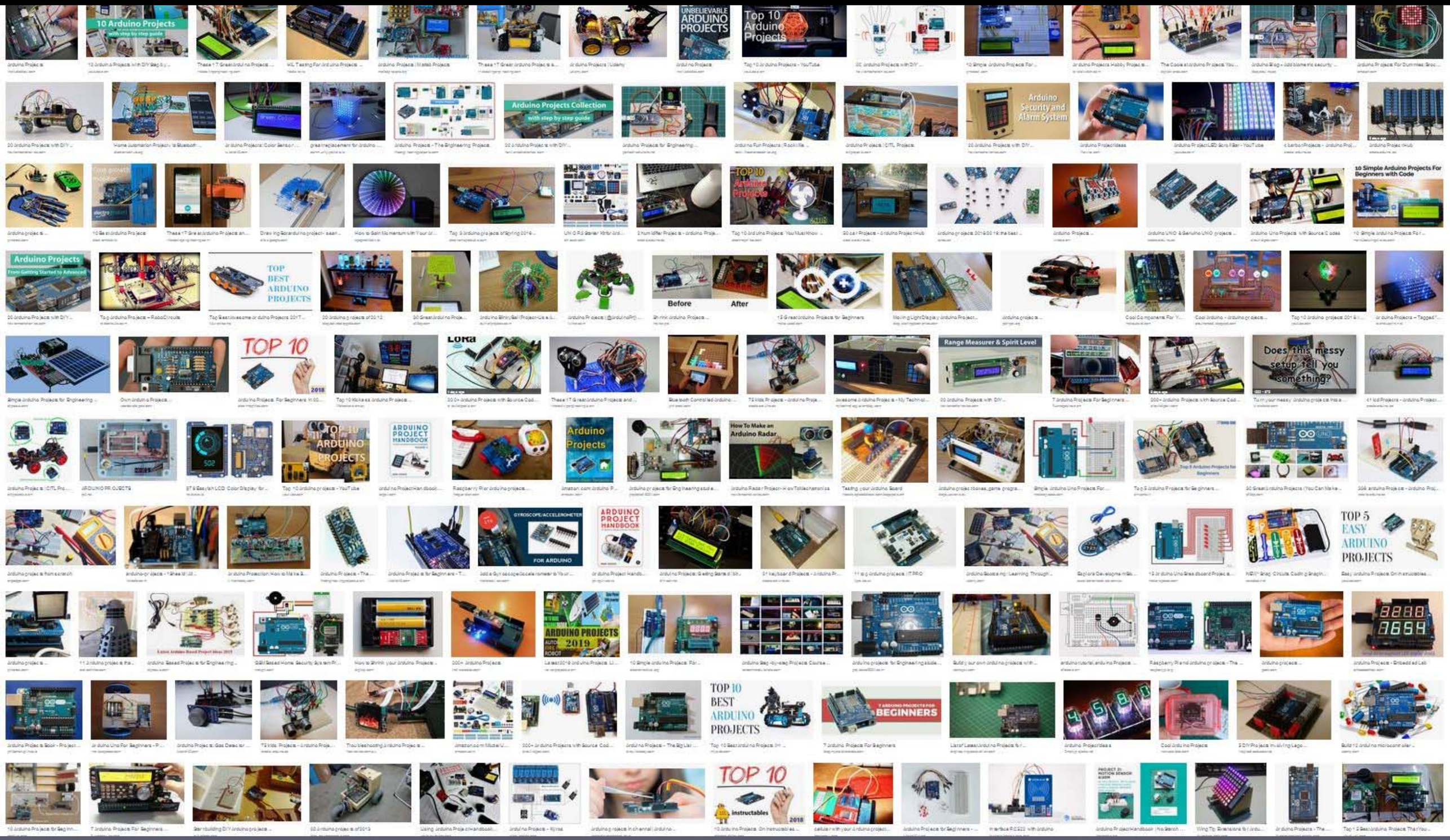






Arduino “Clones”

Intro to Arduino



hundreds of thousands of projects online!

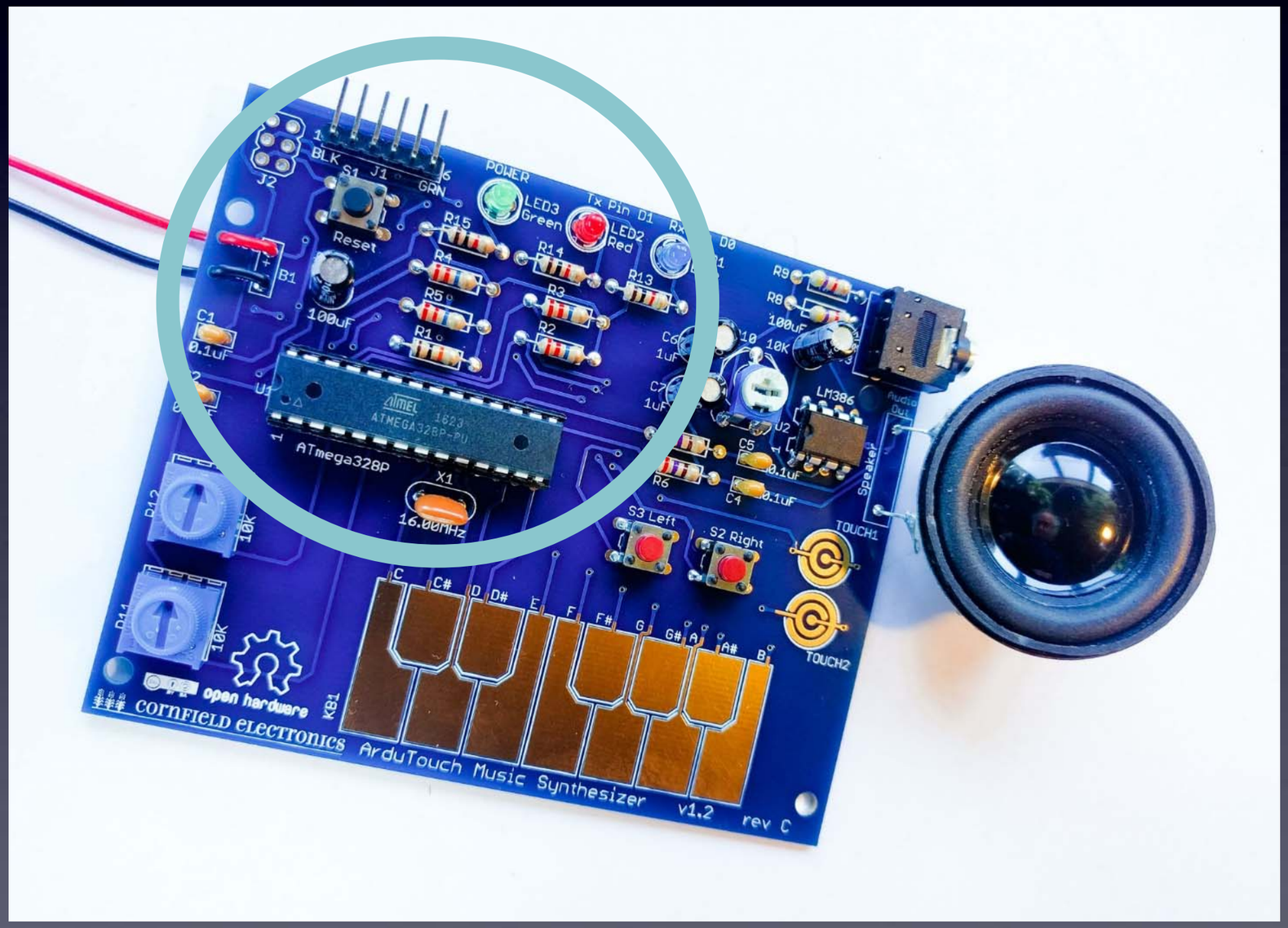
Intro to Arduino

“Arduino-Compatible”

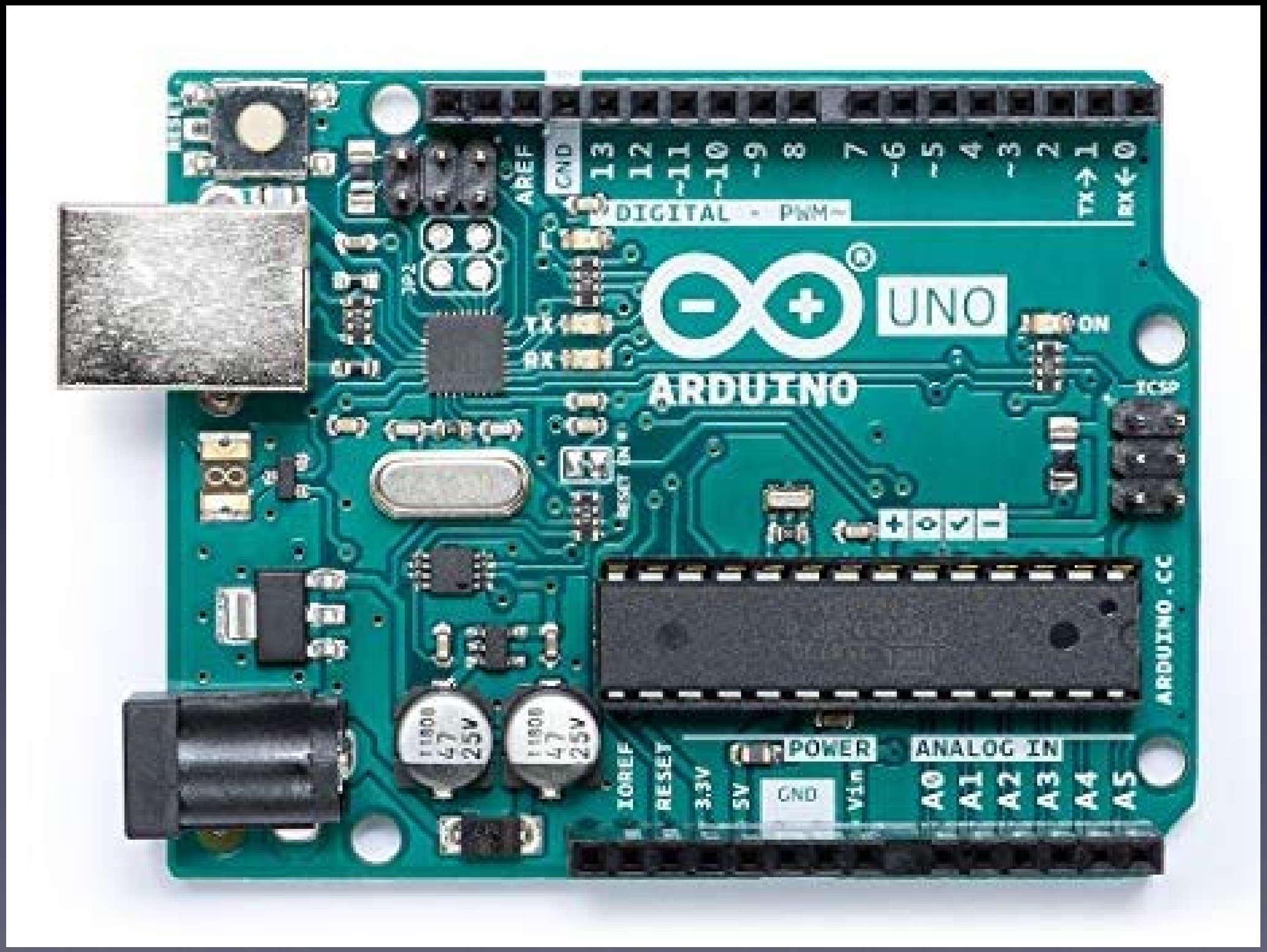
ArduTouch

music synthesizer

kit

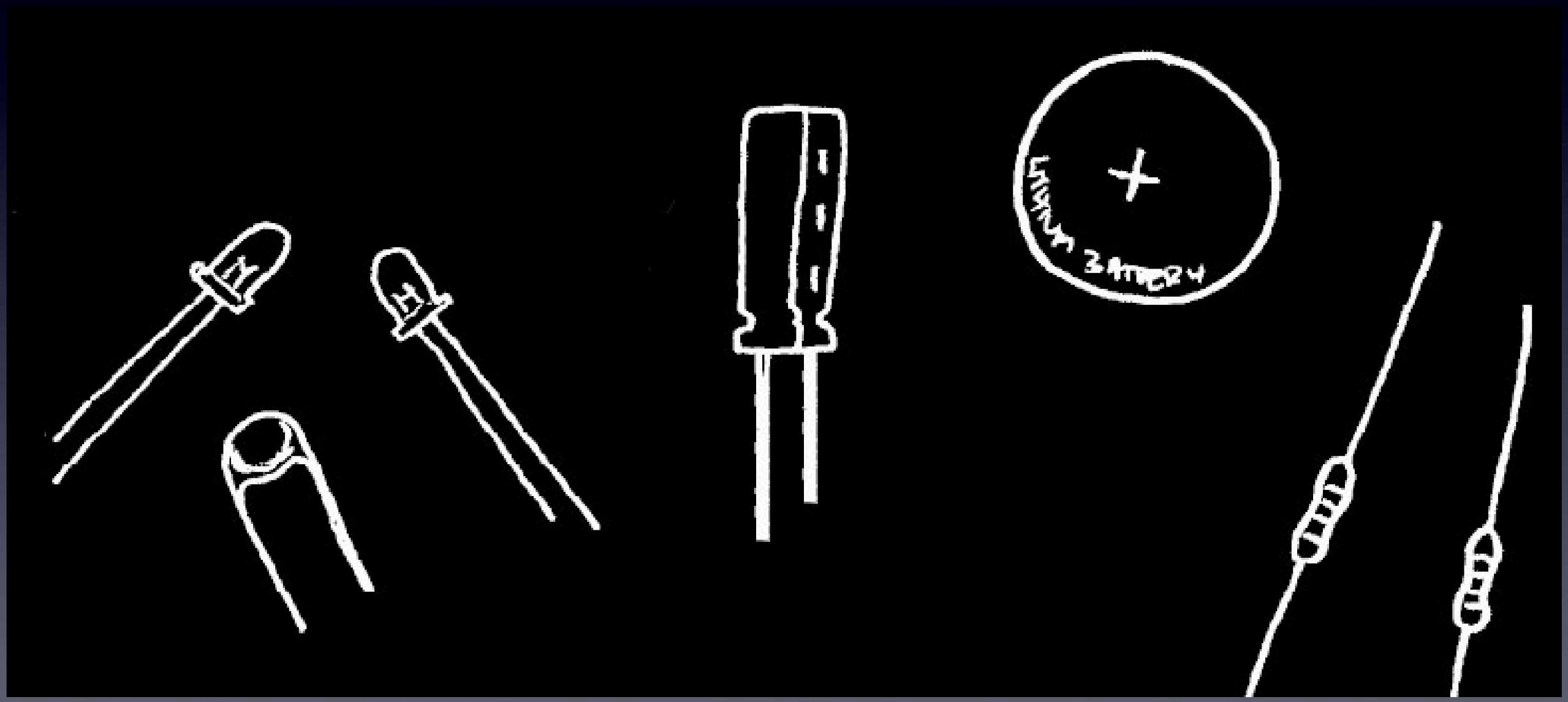


Intro

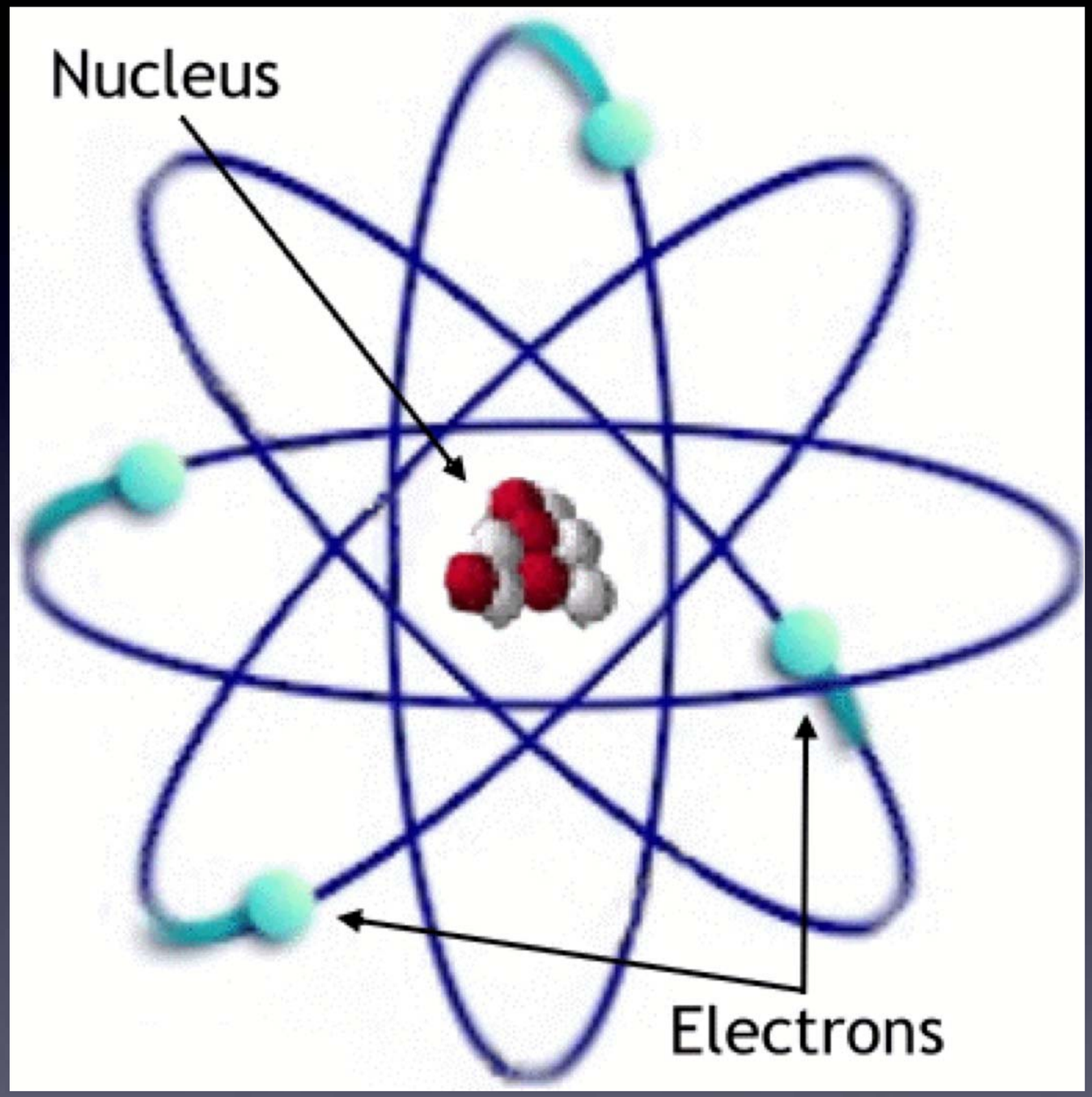

DIGITAL - PWM~
UNO
ARDUINO
ON
ICSP
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
Vin
A0
A1
A2
A3
A4
A5
ARDUINO.CC

Questions?

Everything You Need to Know About ***Electronics***

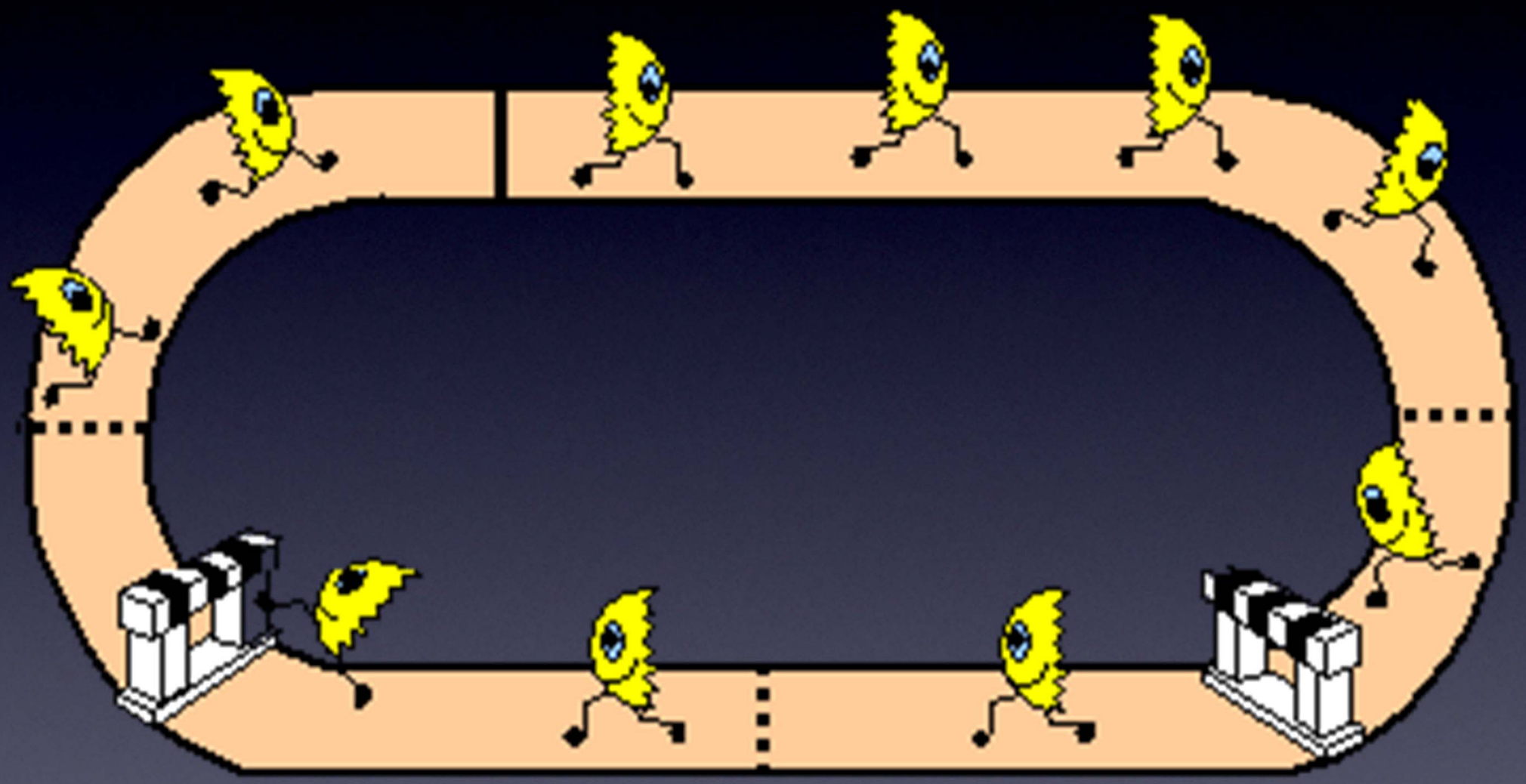


Everything You Need to Know About Electronics



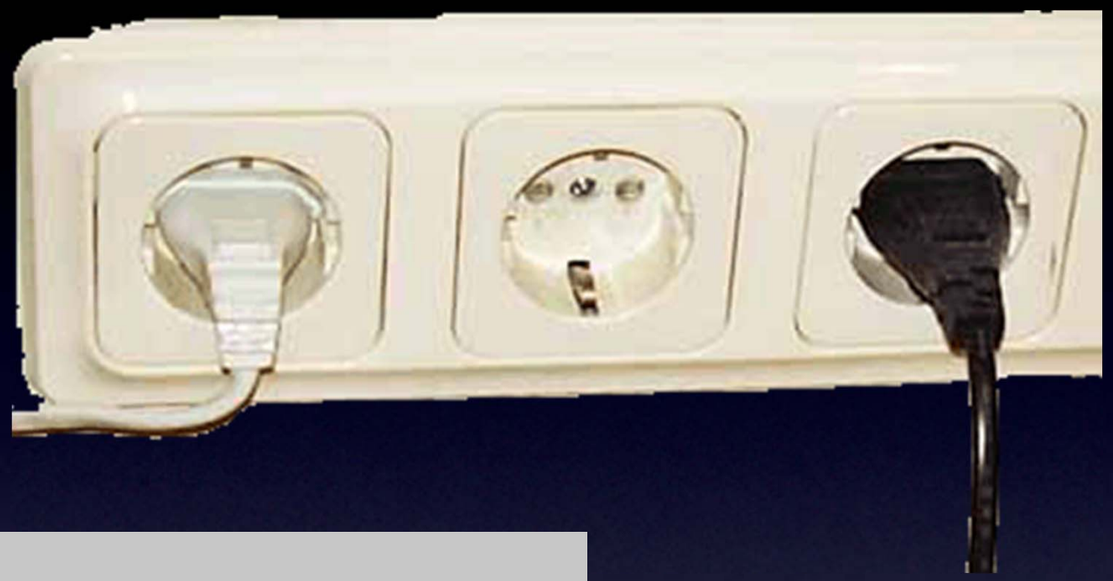
Electrons

Everything You Need to Know About Electronics



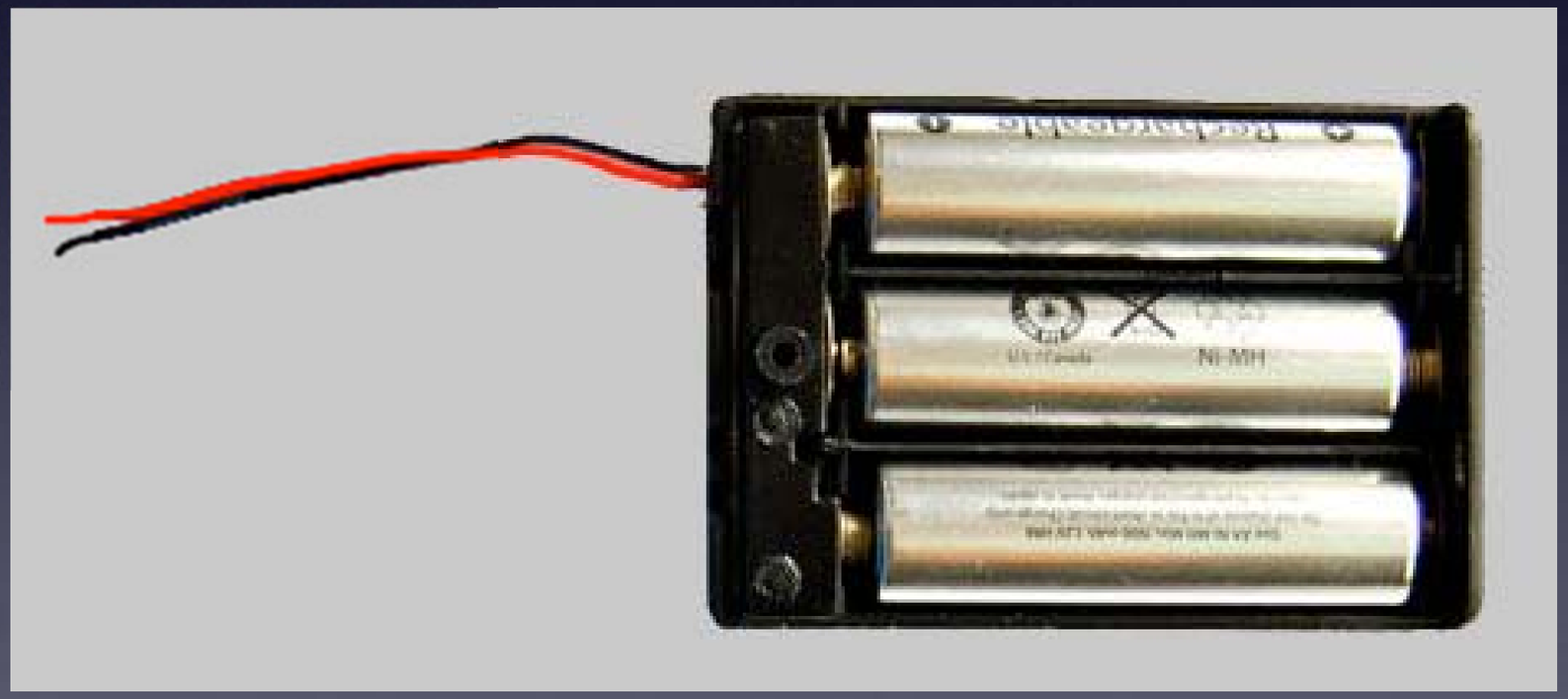
Circuit = Electrons going in complete circle = Magic!

Everything You Need to Know About Electronics



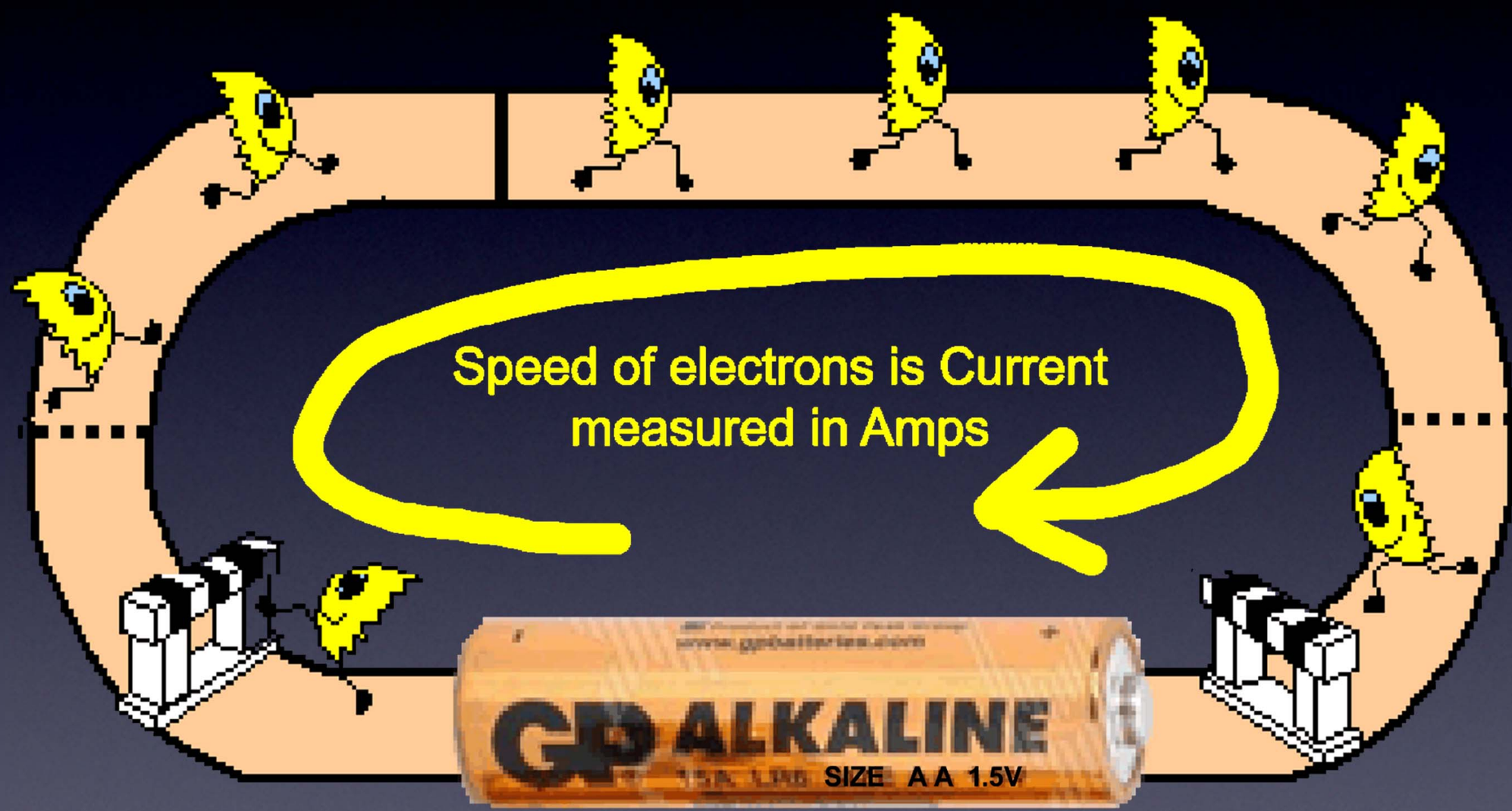
Power Supplies

Everything You Need to Know About Electronics



Voltage / **Volts**

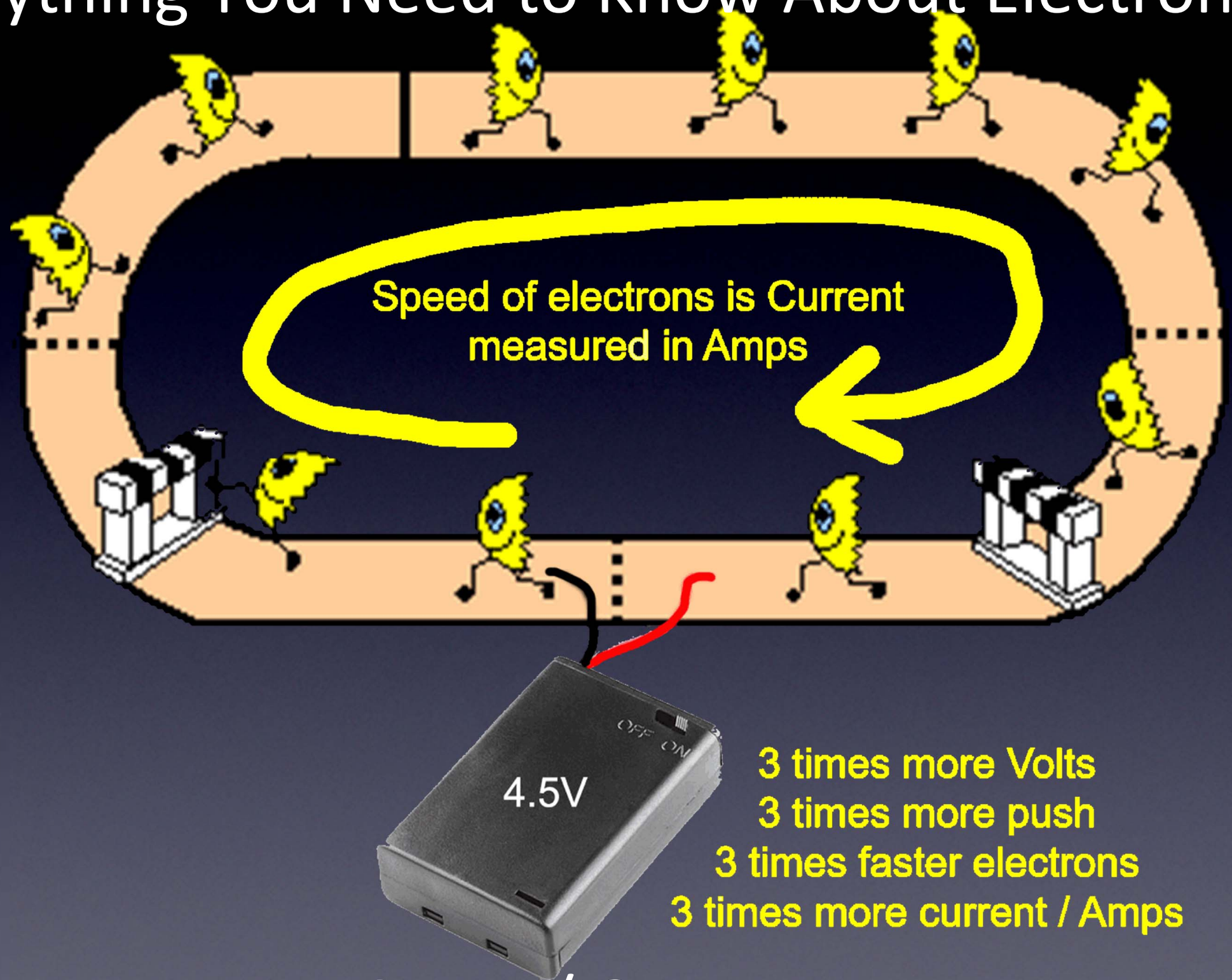
Everything You Need to Know About Electronics



Electrons pushed with 1.5V.
So, they move!

Current / **Amps**

Everything You Need to Know About Electronics



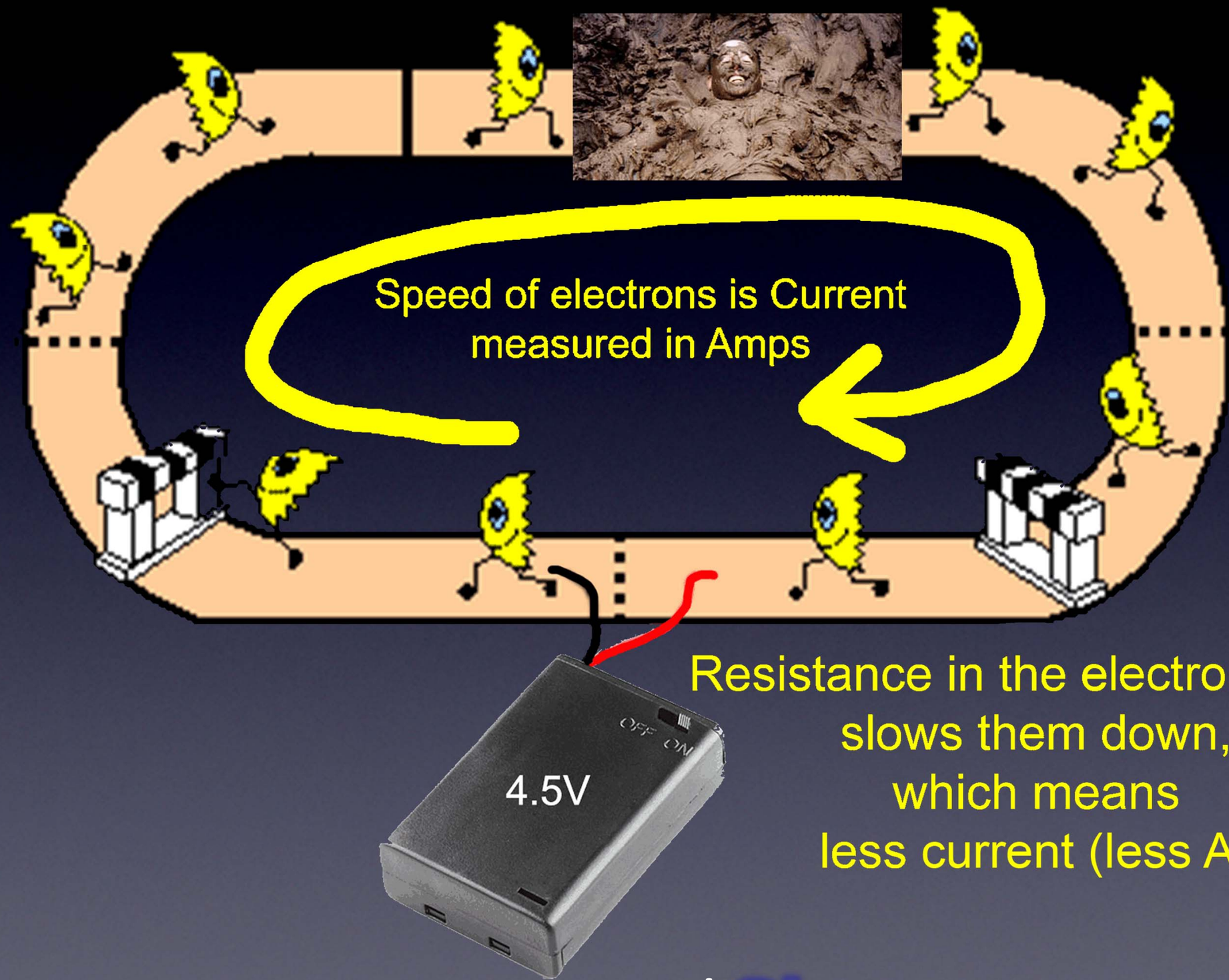
Amps / Current

Everything You Need to Know About Electronics

Too much energy?

Amps / Current

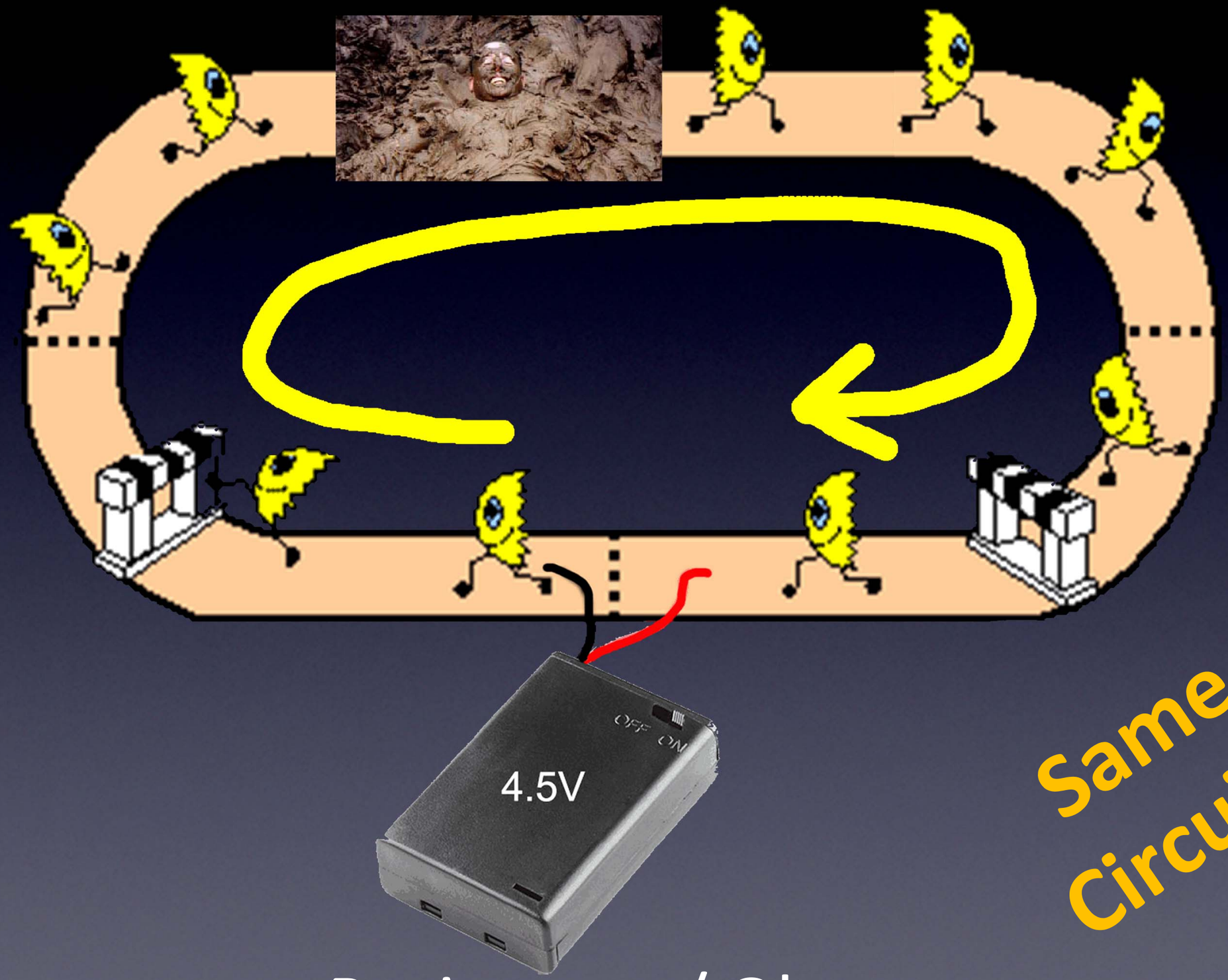
Everything You Need to Know About Electronics



Resistance in the electrons' path
slows them down,
which means
less current (less Amps).

Resistance / **Ohms**

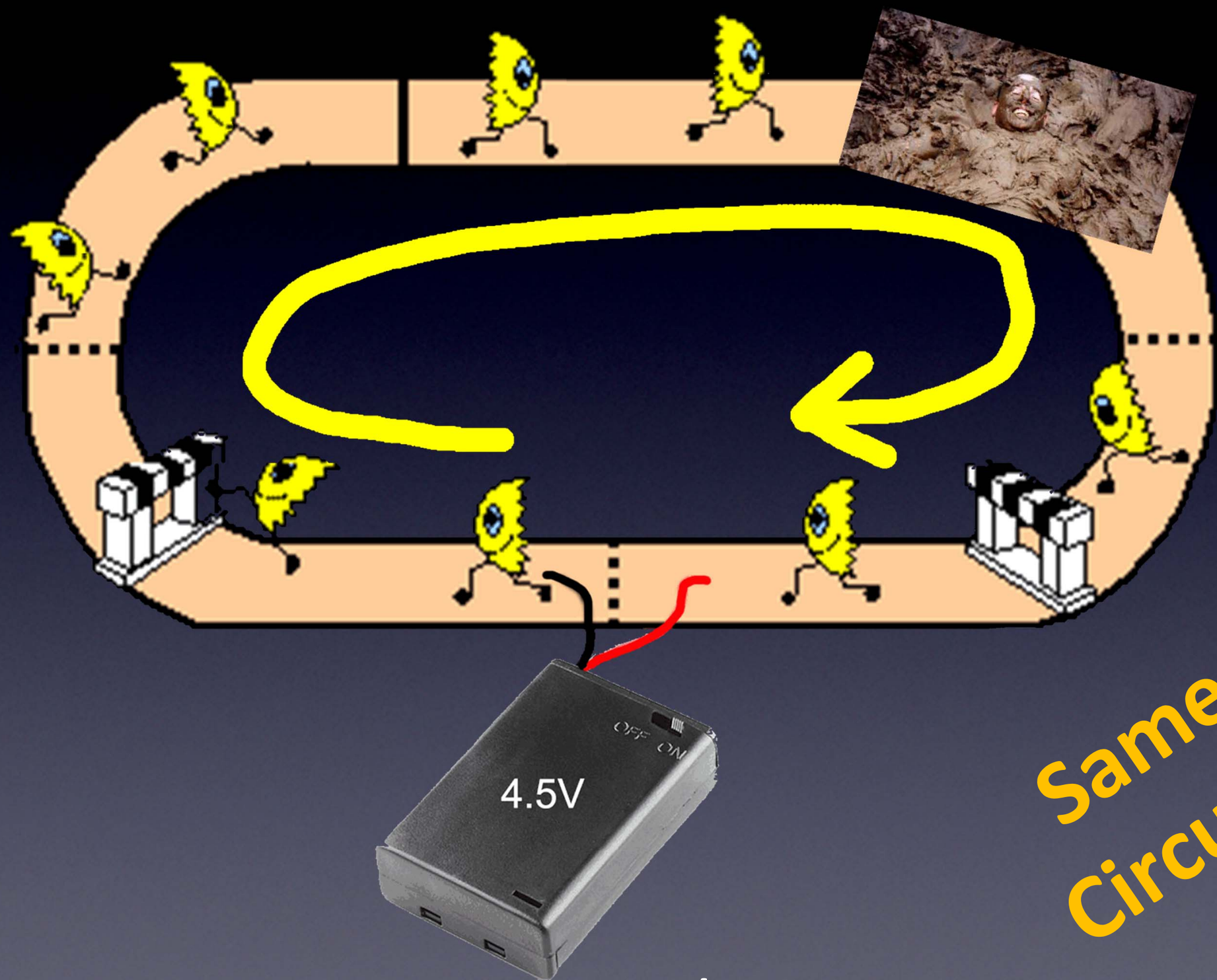
Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

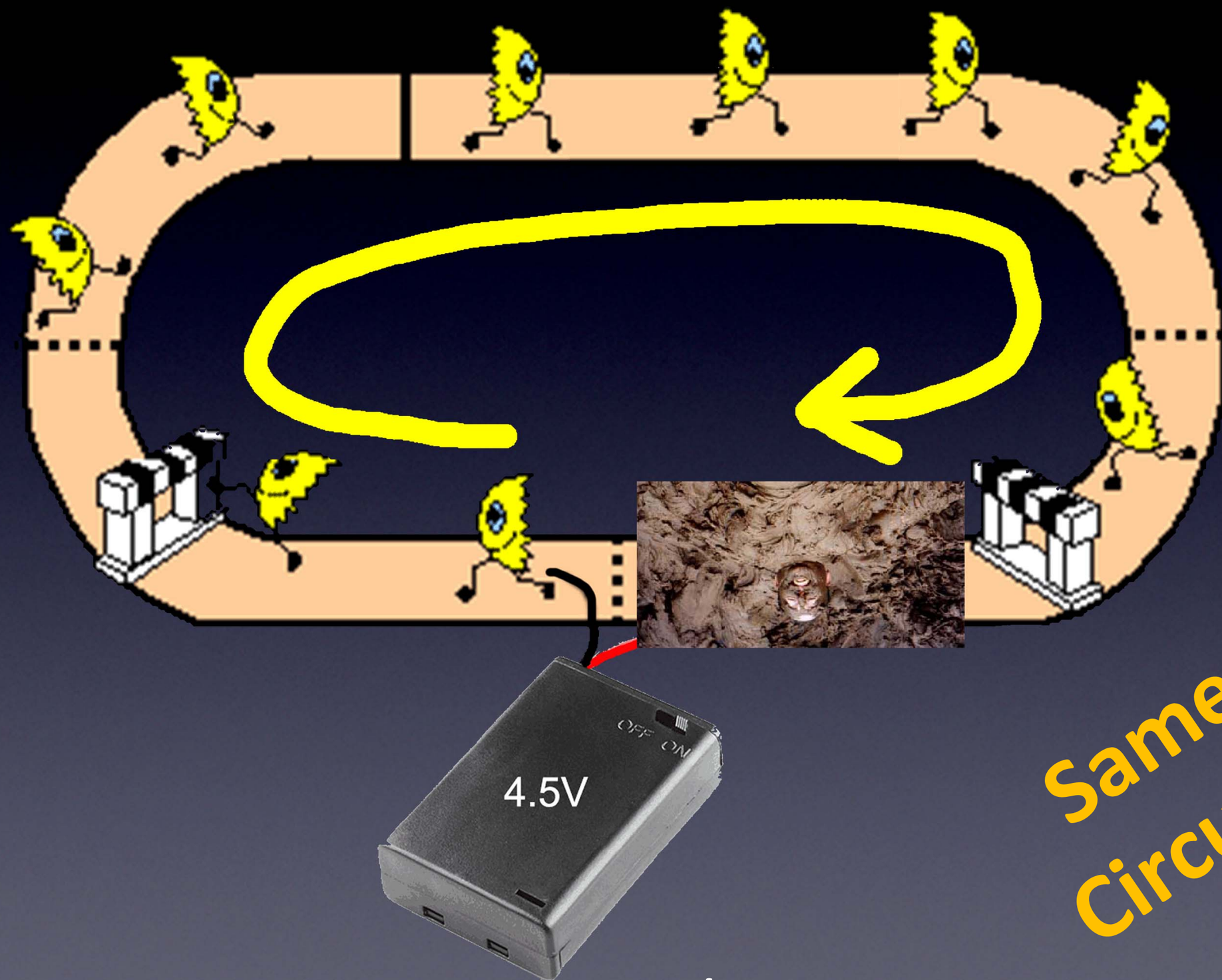
Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

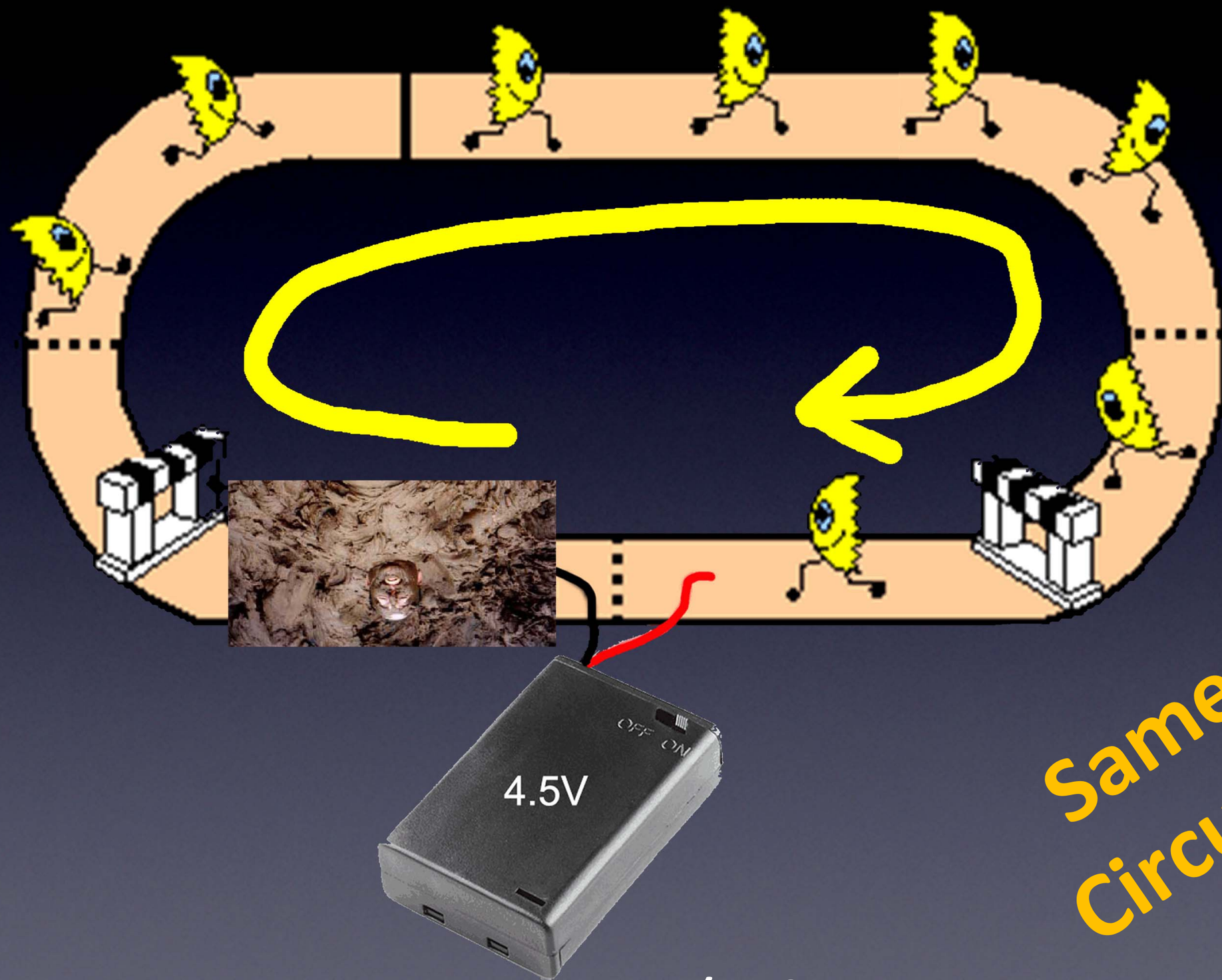
Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

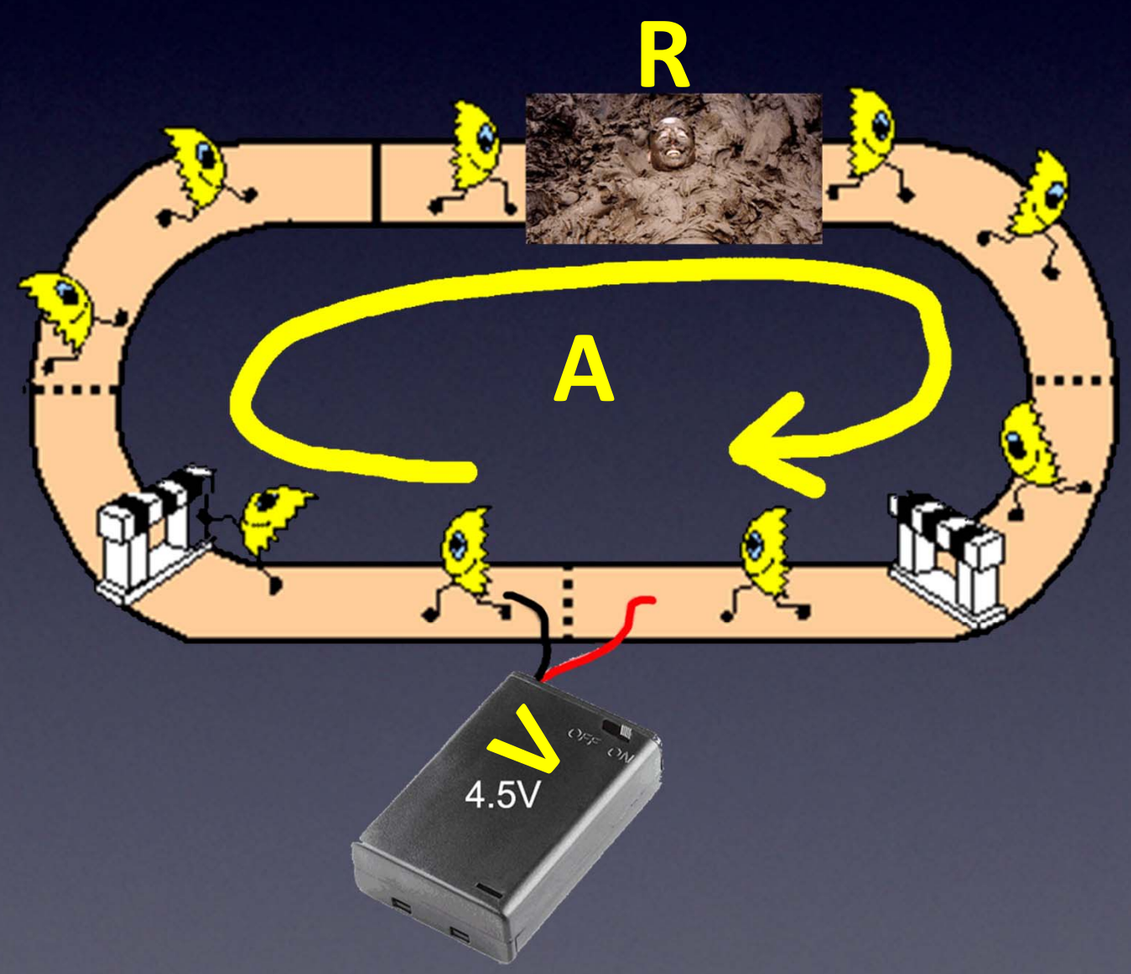
Everything You Need to Know About Electronics

Ohm's Law

Volts -- ***force*** pushing electrons

Amps -- ***speed*** of electrons

Ohms -- ***Resistance*** to flow of electrons



Everything You Need to Know About Electronics

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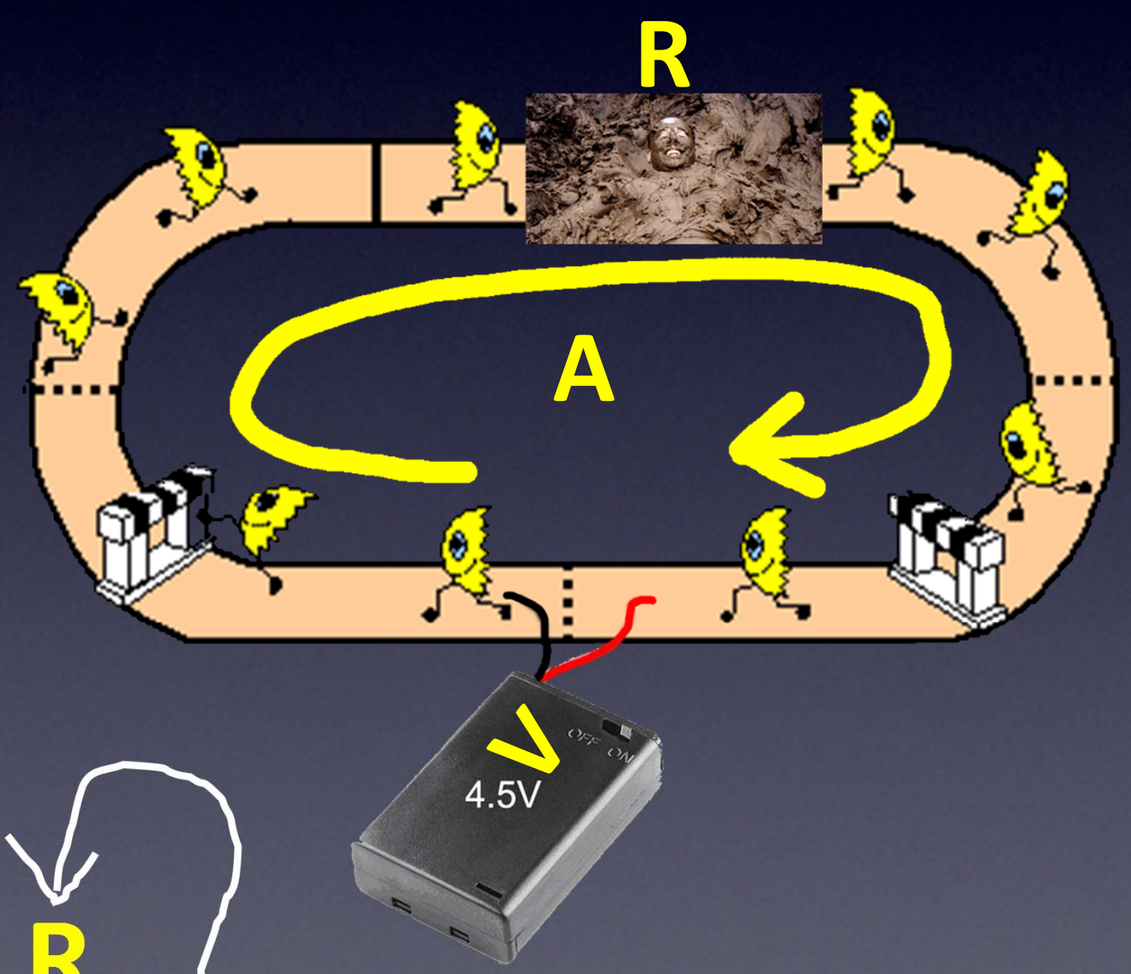


Volts = **A**mps x **R**

(Ohms)

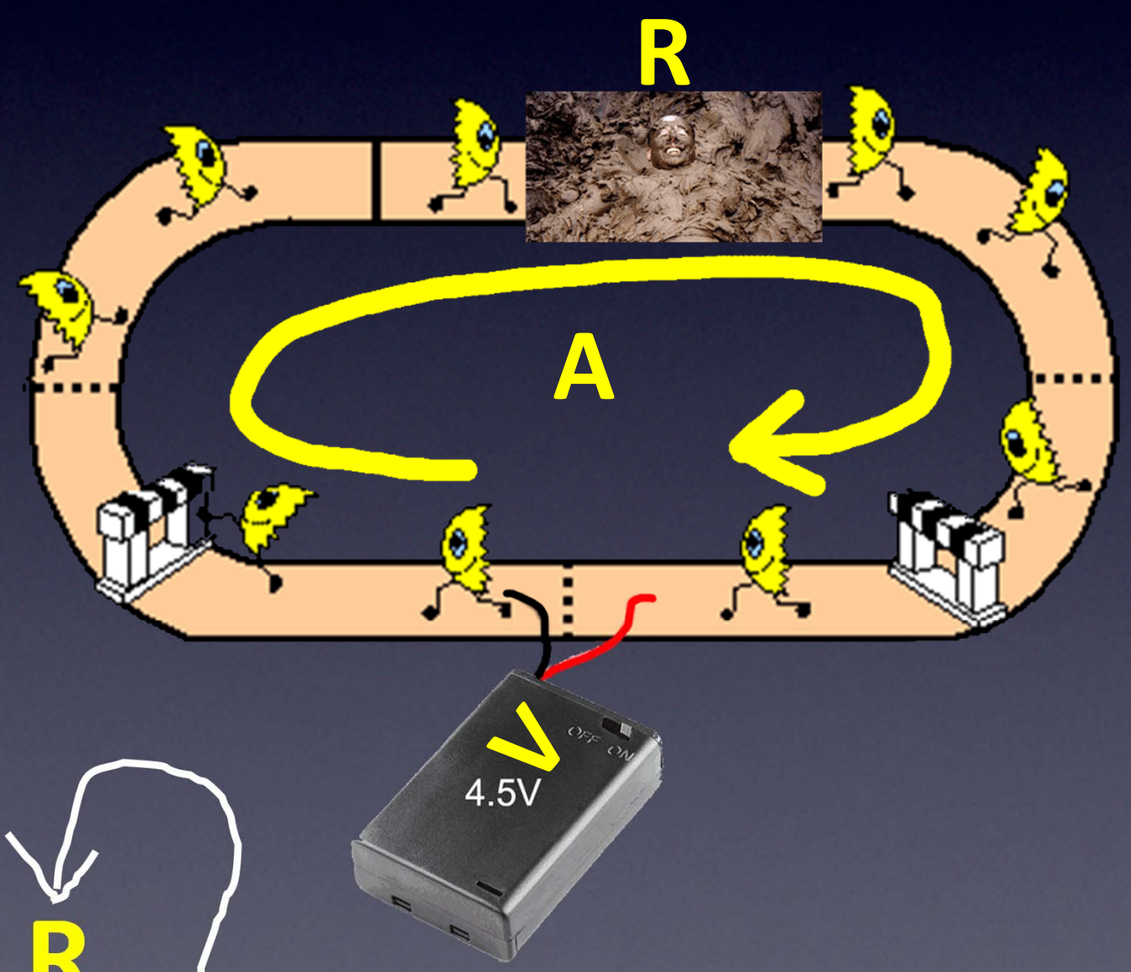
Everything You Need to Know About Electronics

Ohm's Law

Volts -- ***force*** pushing electrons

Amps -- ***speed*** of electrons

Ohms -- ***Resistance*** to flow of electrons



Volts = **A**mps x **R**

(Ohms)

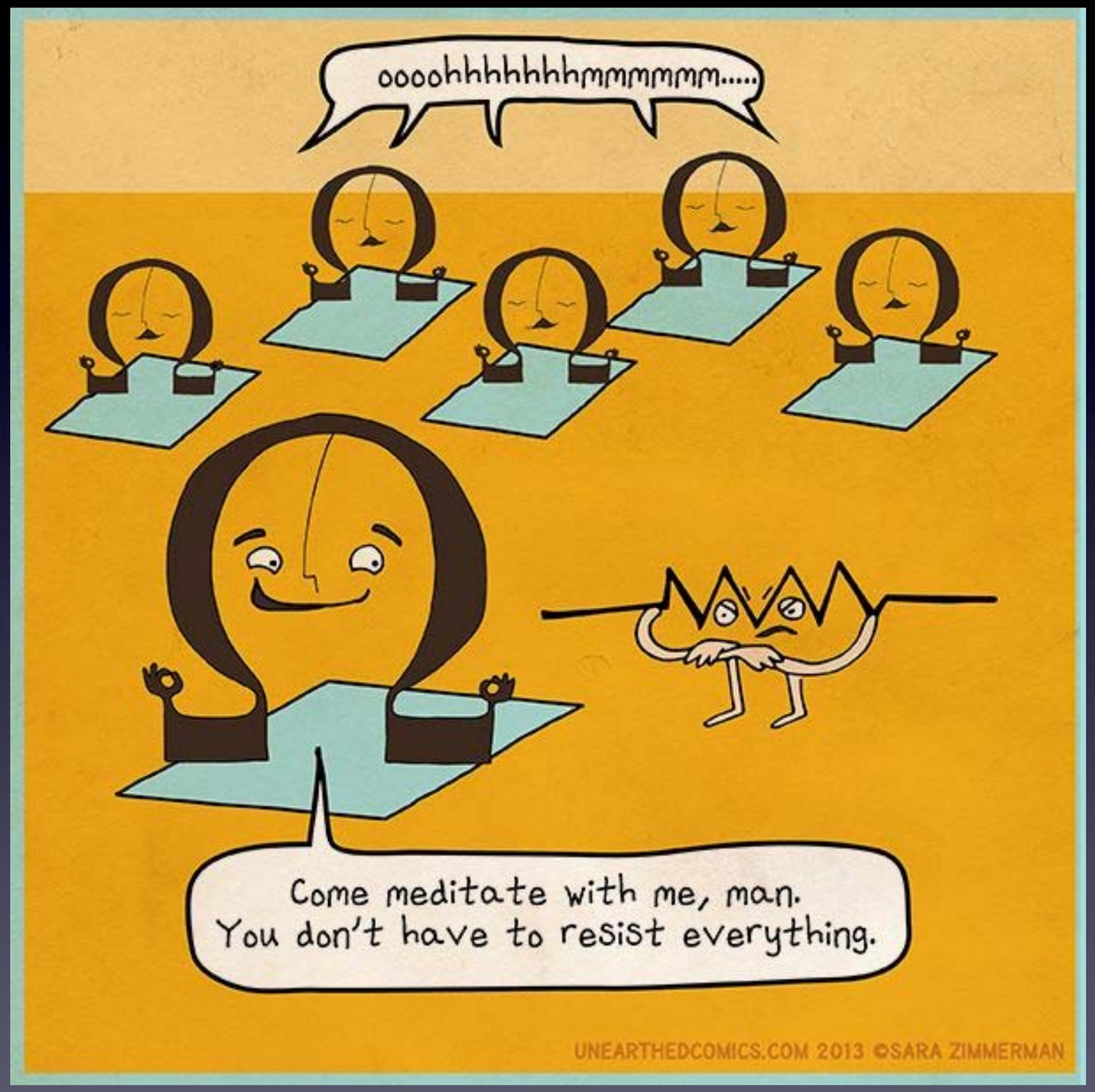
Also commonly written: **E** = **I** x **R**

Everything You Need to Know About Electronics

The symbol for

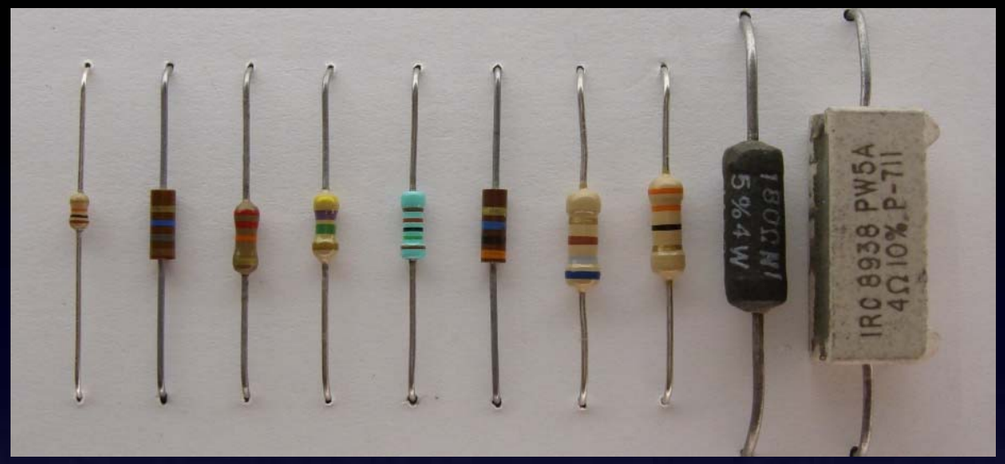
Resistance:

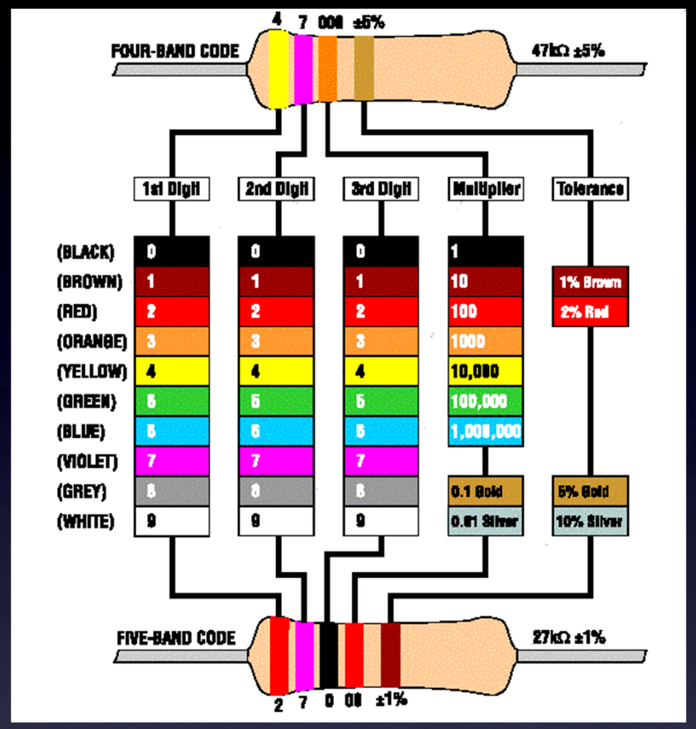
Ω



Resistor / Ohms

What You Need to Know About Electronics





Resistor / Ohms

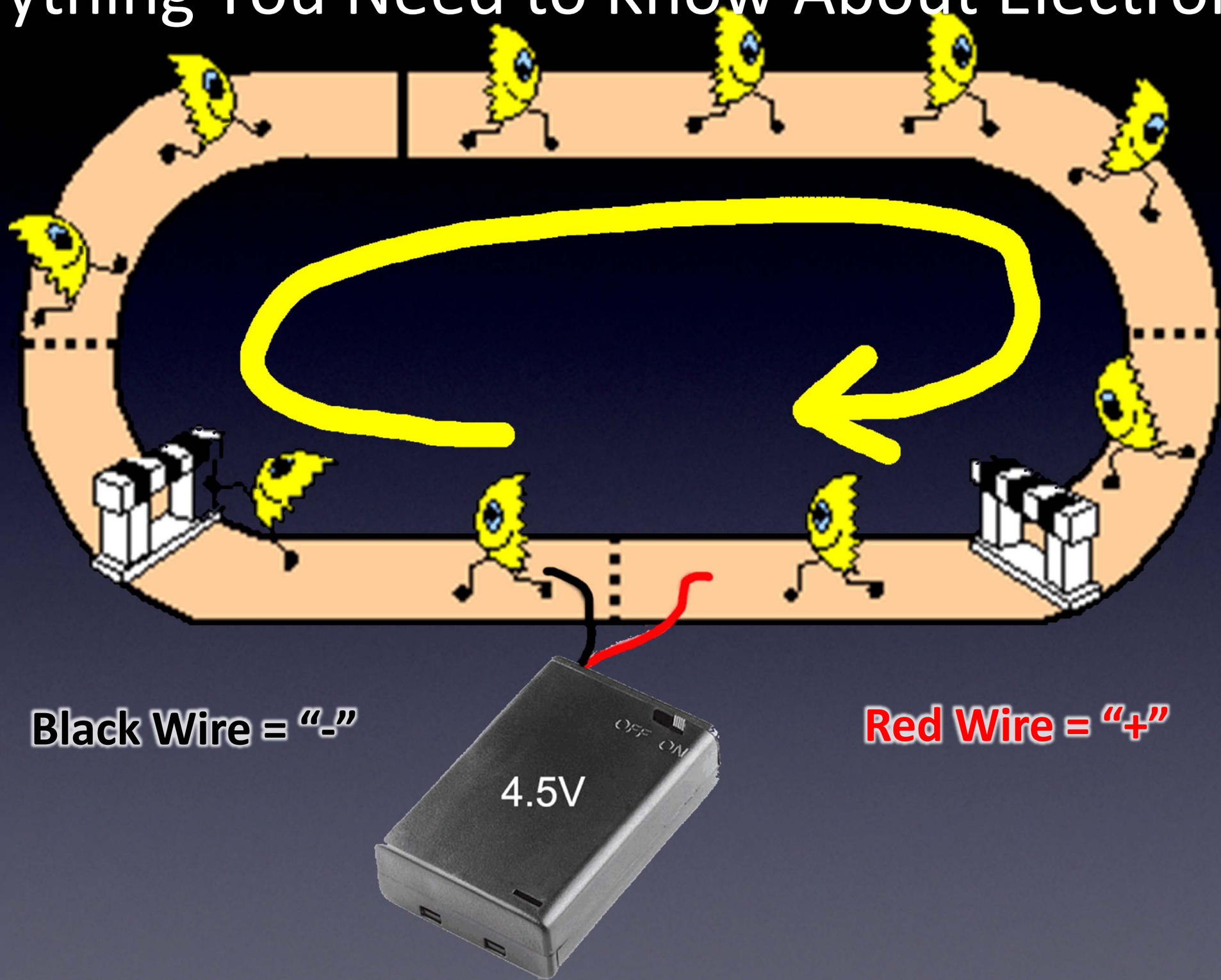
Everything You Need to Know About Electronics

What happens?

Polarity

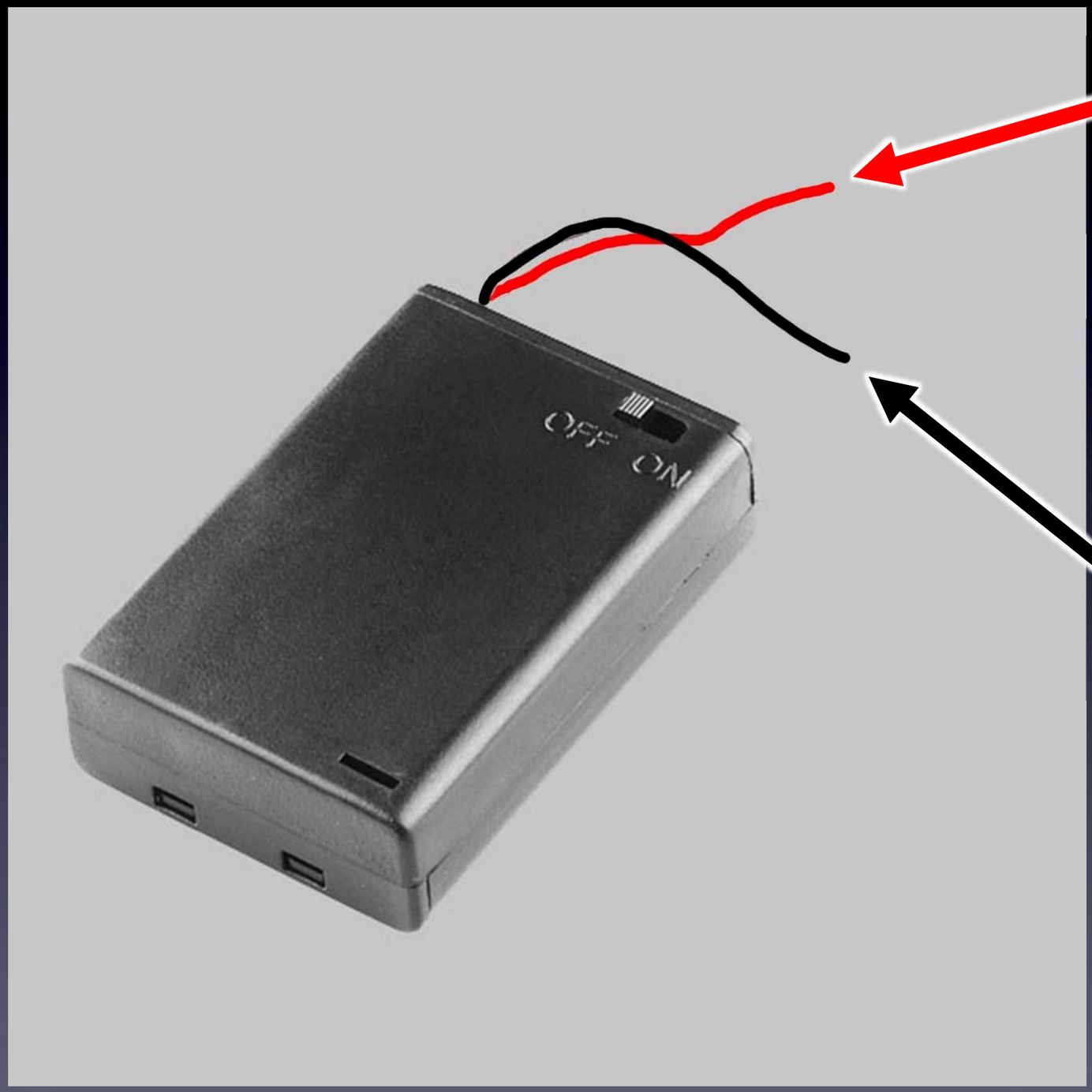
Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics



Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics



Red wire:
Power,
Plus, Positive,
4.5V,
Vcc

Black wire:
Minus, Negative,
0V,
Ground (GND)

Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics

or

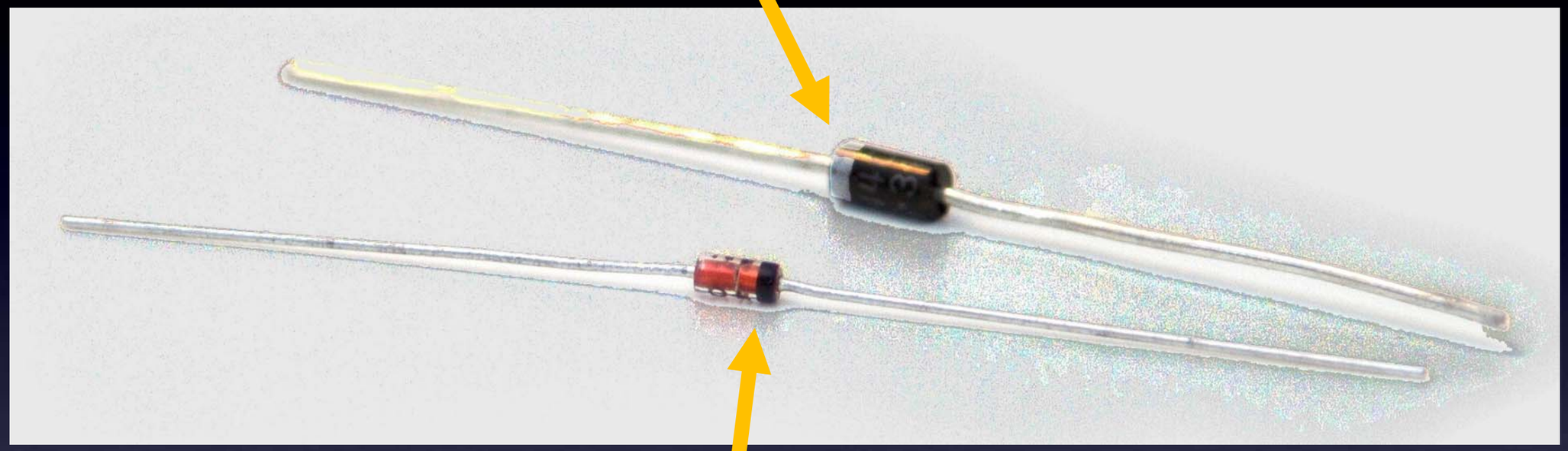
or

(electrons slowed down the same either way)

Resistors – it doesn’t matter which way

Everything You Need to Know About Electronics

Minus / Negative side



Minus / Negative side

Diodes – One-Way valve for electrons

Diodes – it matters which way!

Everything You Need to Know About Electronics

Short wire is Minus / Negative

Special kind of Diode – it Emits Light!

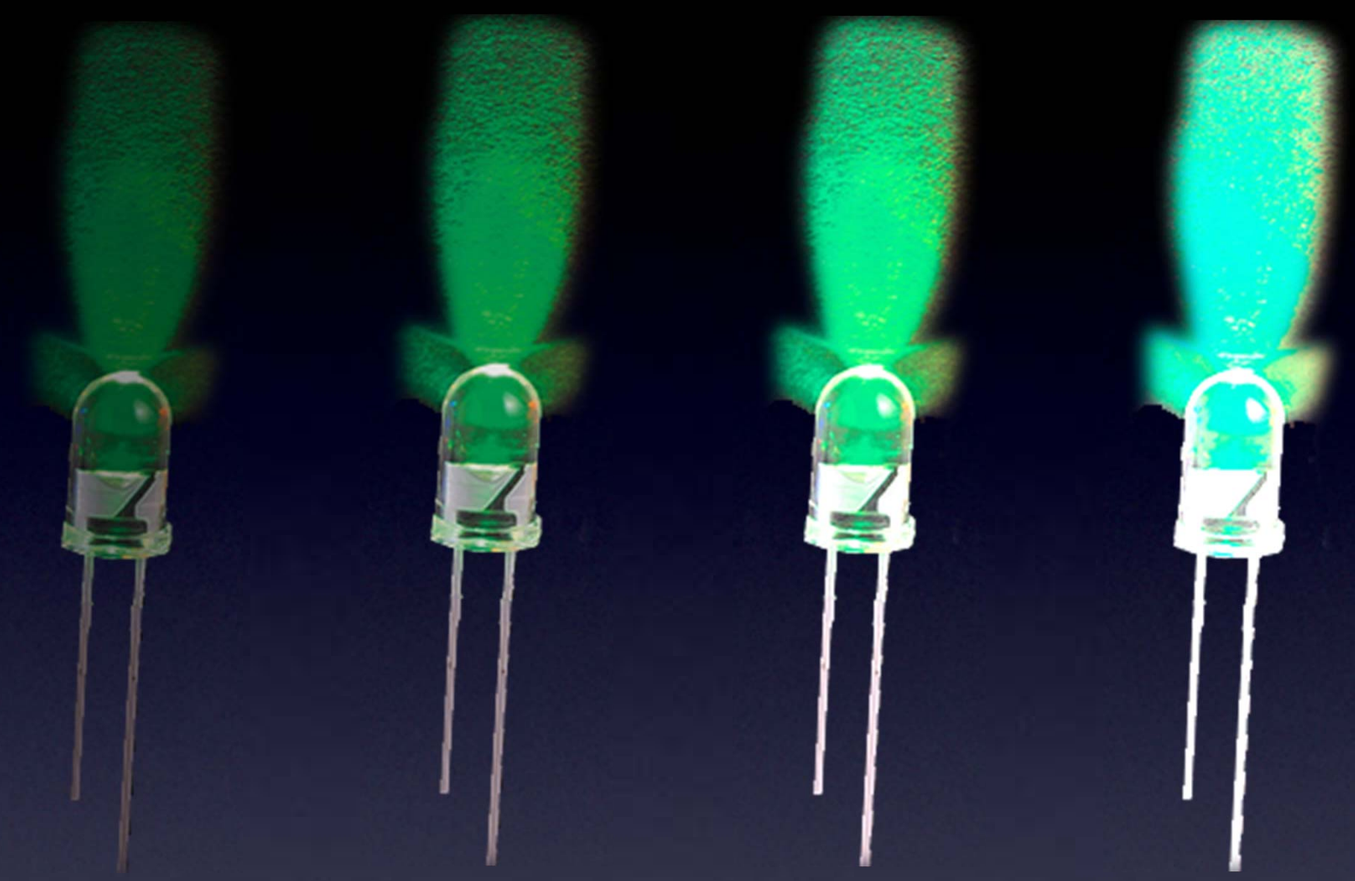
LED – it matters which way!

Everything You Need to Know About Electronics

Lots of different colored LEDs! (including IR)

LED

Everything You Need to Know About Electronics



More current → More brightness! (until…)

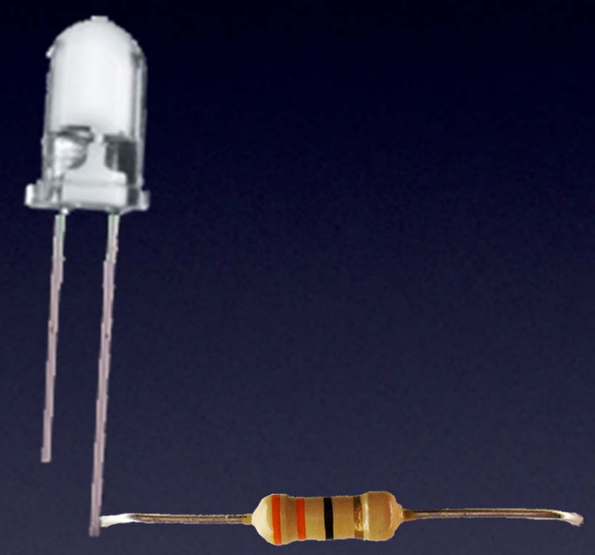
LED

Everything You Need to Know About Electronics

More current → More brightness! (until…)

LED

Everything You Need to Know About Electronics

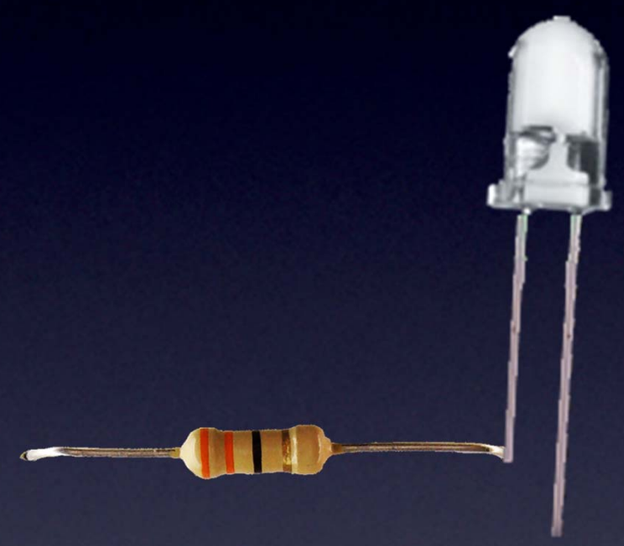


(with a resistor
so no magic smoke goes away)

This is why we put a resistor in line with an LED

LED

Everything You Need to Know About Electronics



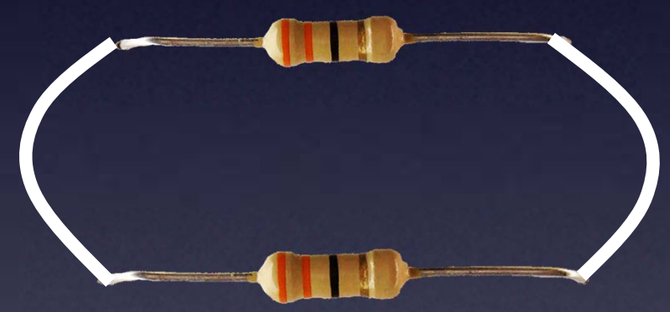
(the resistor can go on either side)

This is why we put a resistor in line with an LED

LED

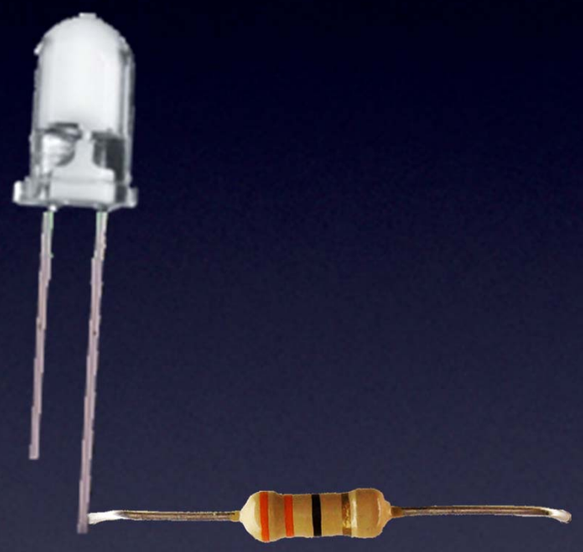
Everything You Need to Know About Electronics

Series = in line



Parallel = across

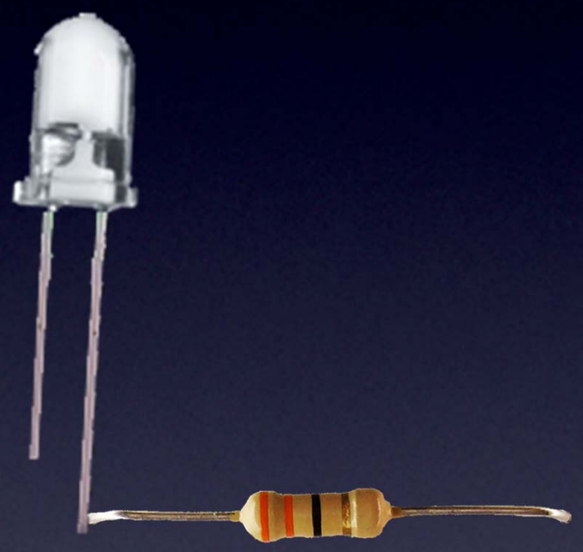
Everything You Need to Know About Electronics



Let’s make this light up!

LED

Everything You Need to Know About Electronics

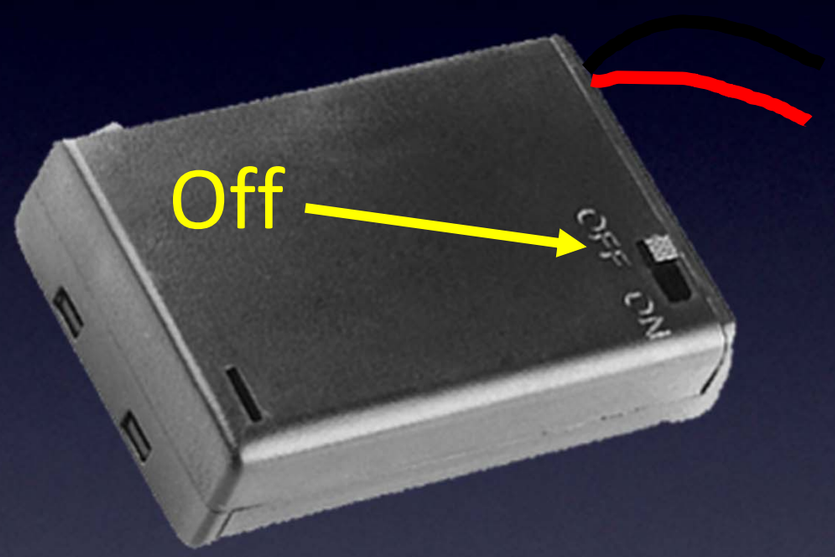


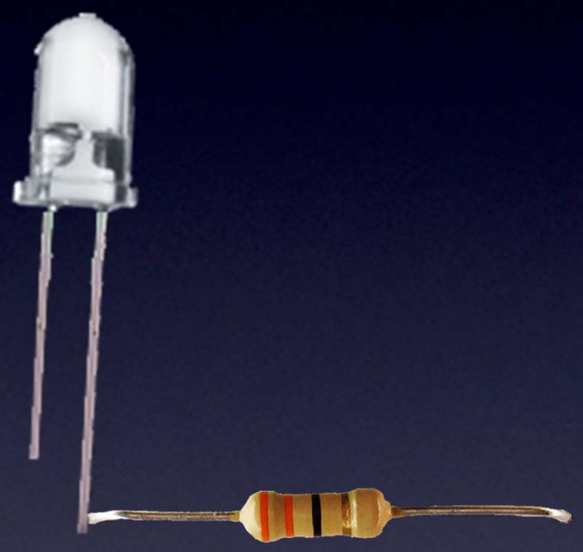
(add a power supply)

Let’s make this light up!

LED

Everything You Need to Know About Electronics



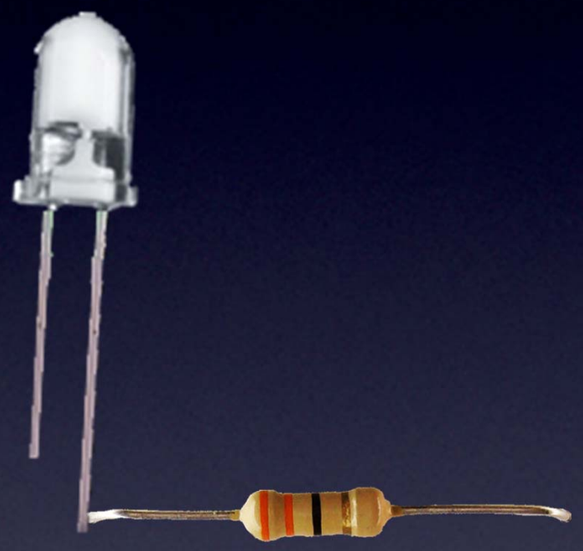


Let’s make this light up!

LED

Everything You Need to Know About Electronics

Black wire: "-" (ground)

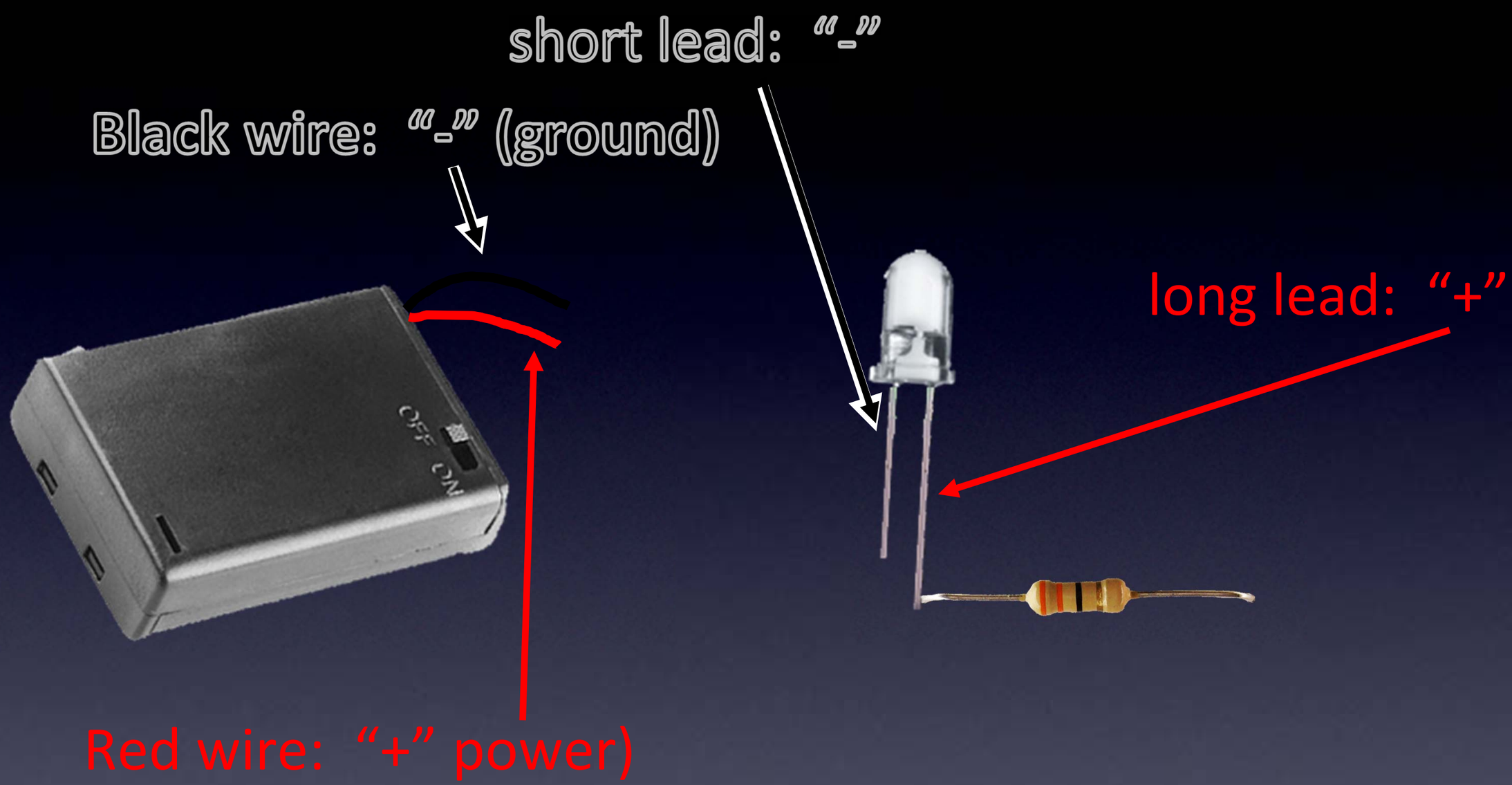


Red wire: "+" power)

Let's make this light up!

LED

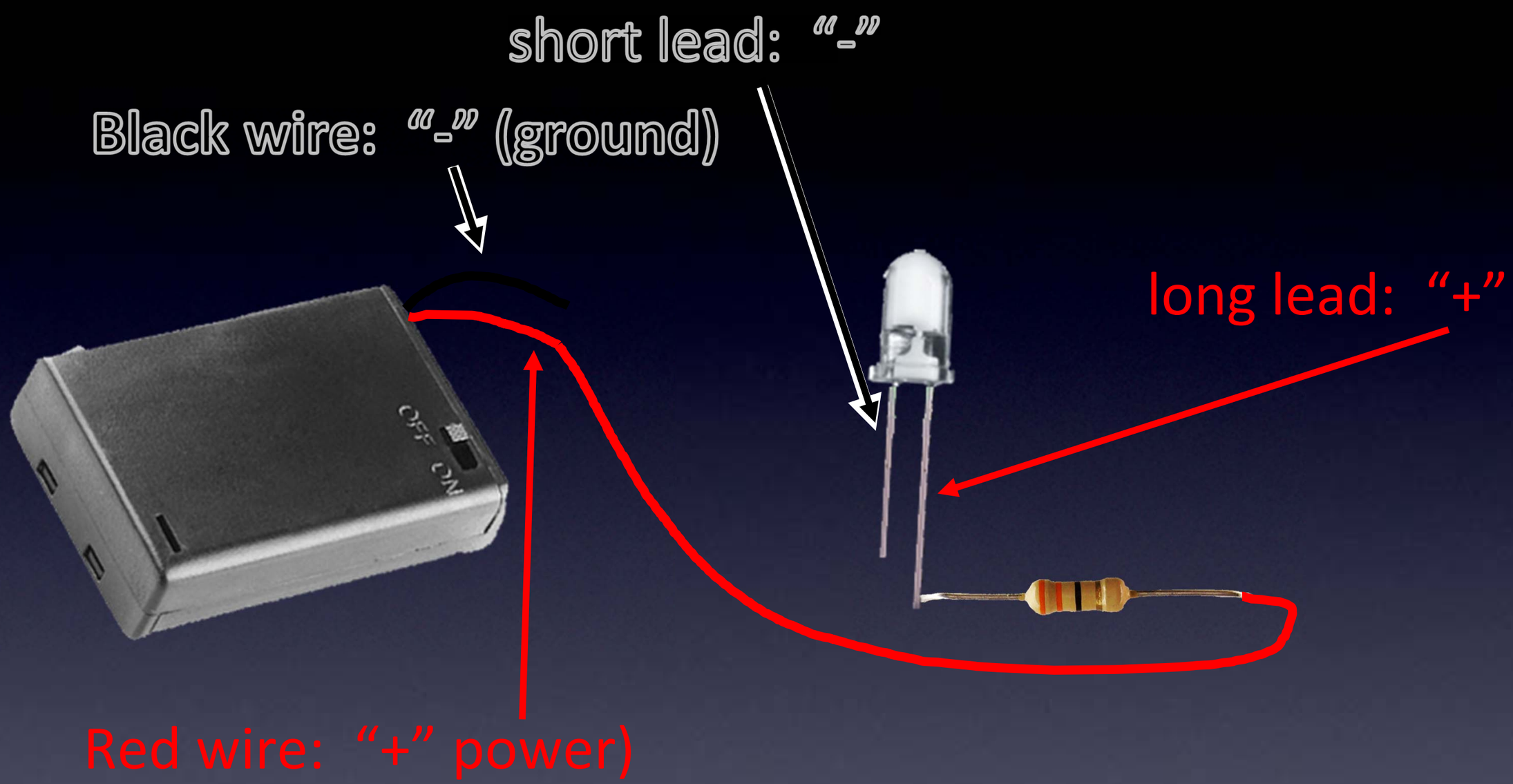
Everything You Need to Know About Electronics



Let's make this light up!

LED

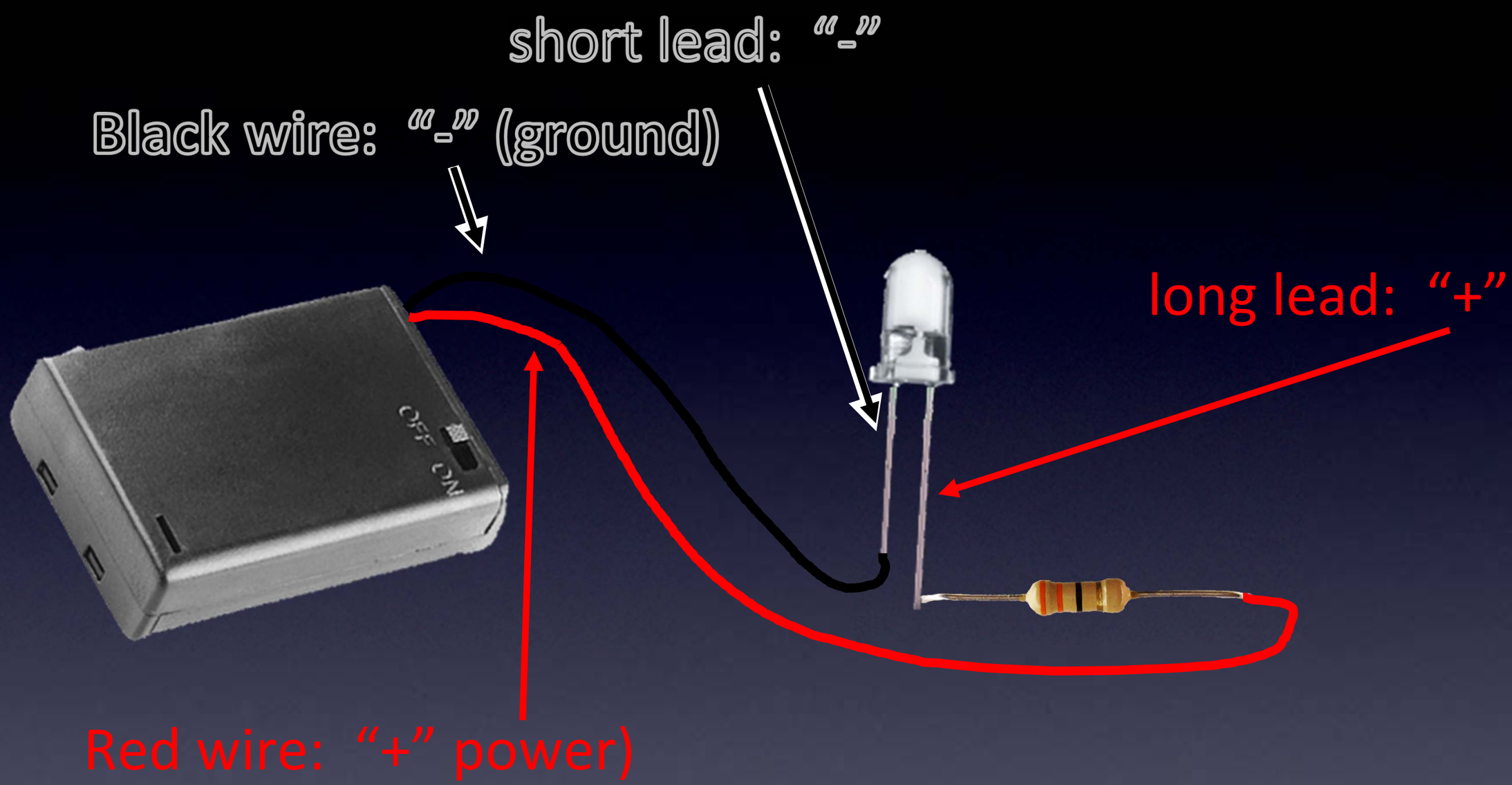
Everything You Need to Know About Electronics



Let's make this light up!

LED

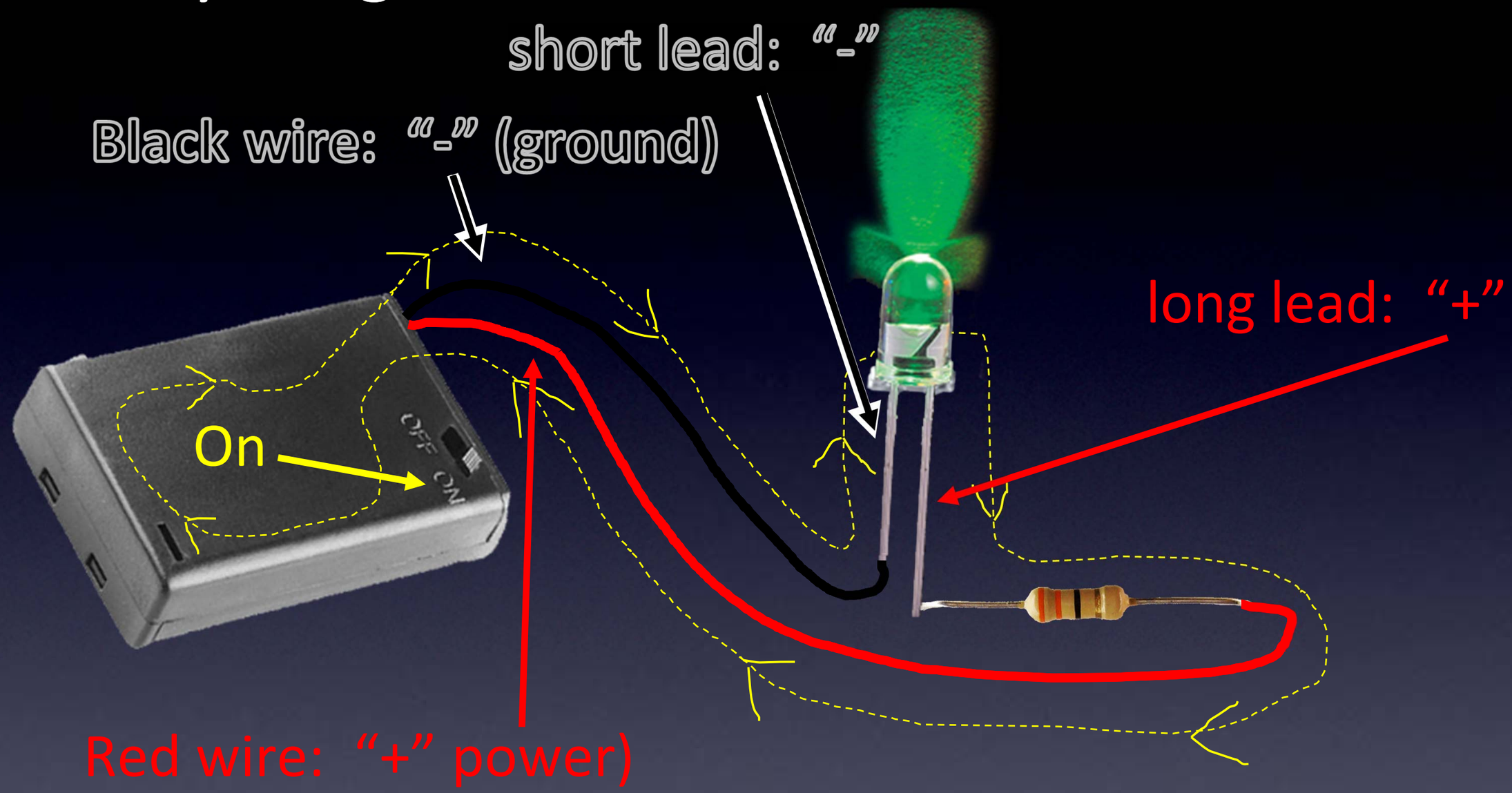
Everything You Need to Know About Electronics



Let's make this light up!

LED

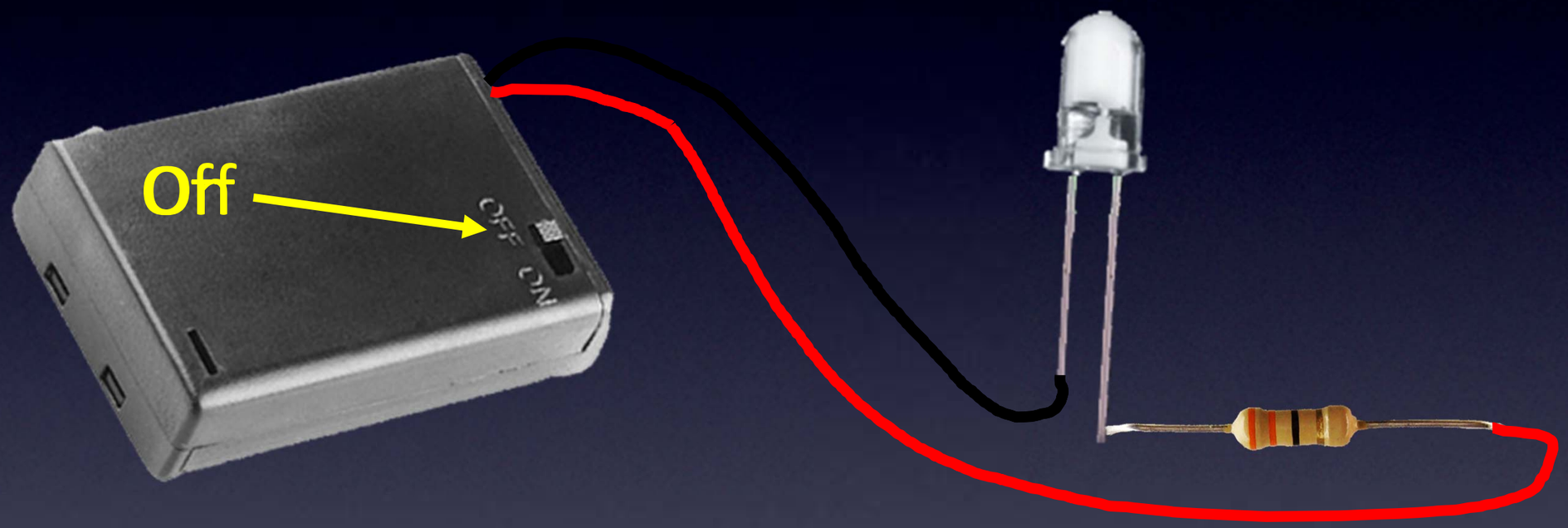
Everything You Need to Know About Electronics



It lights!

LED

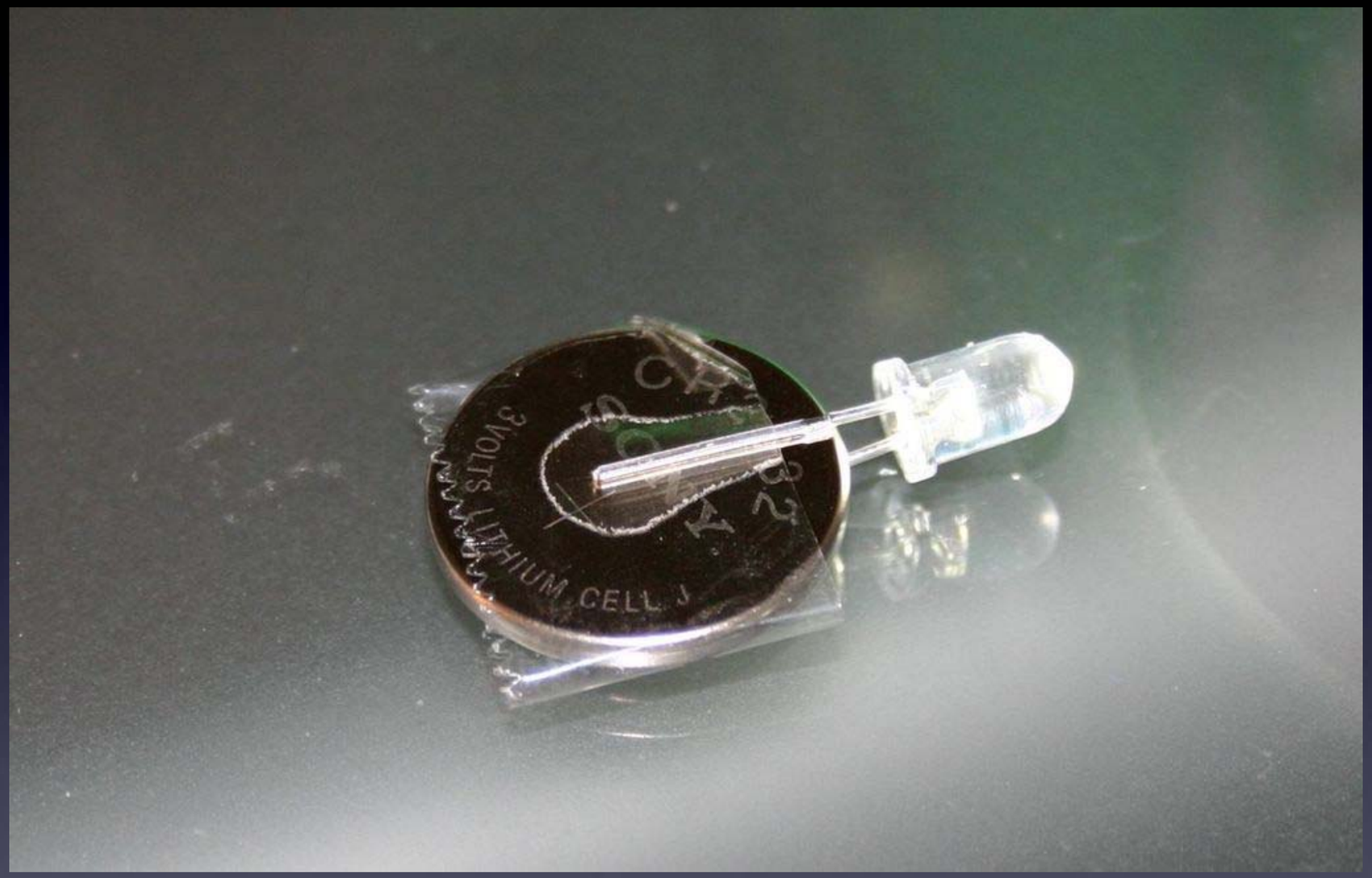
Everything You Need to Know About Electronics



It’s off

LED

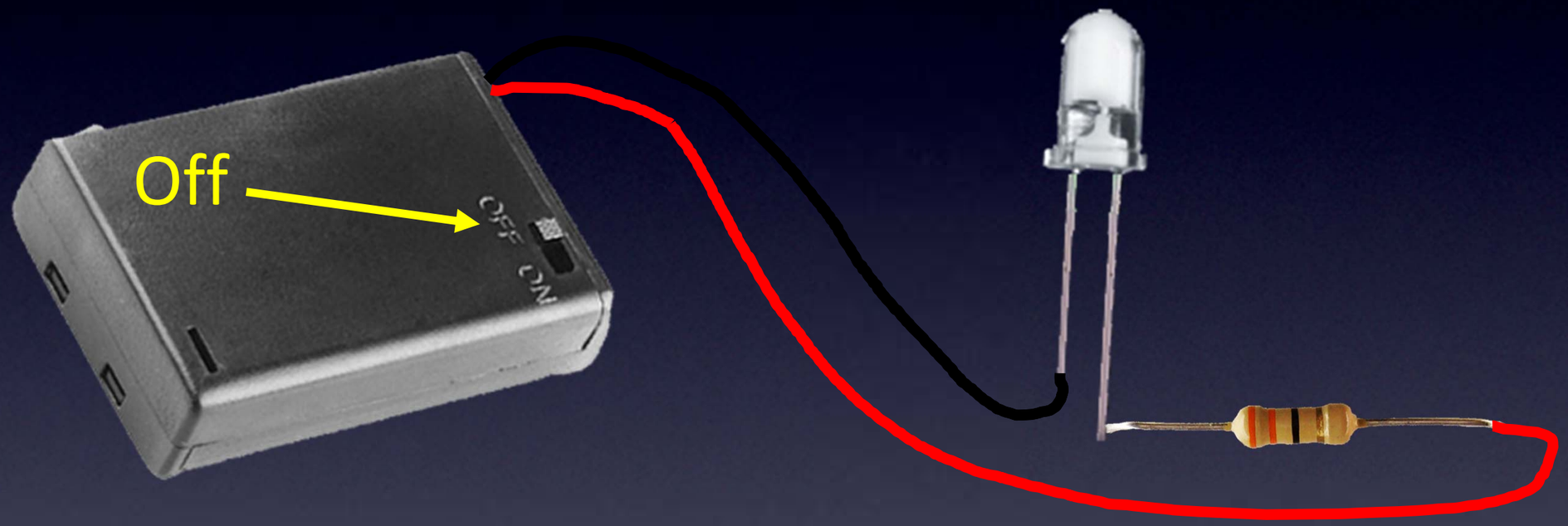
Everything You Need to Know About Electronics



LED & battery

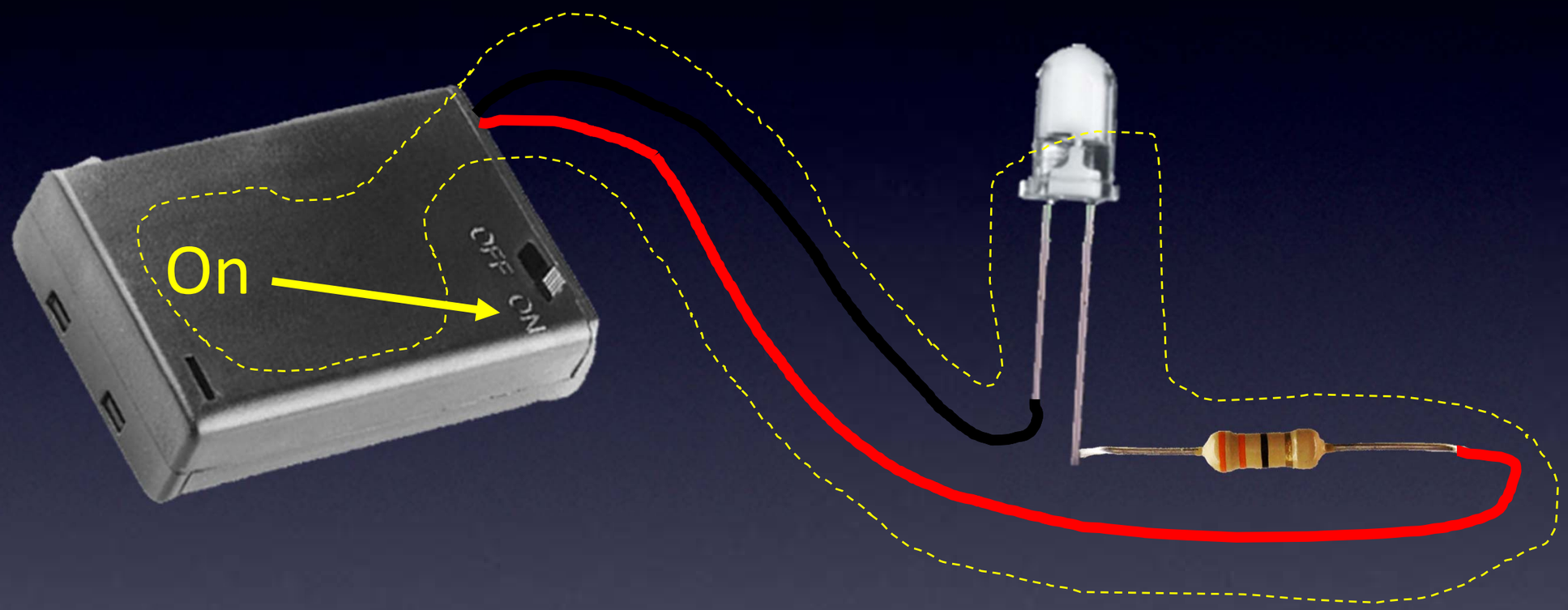
Our first circuit

Everything You Need to Know About Electronics



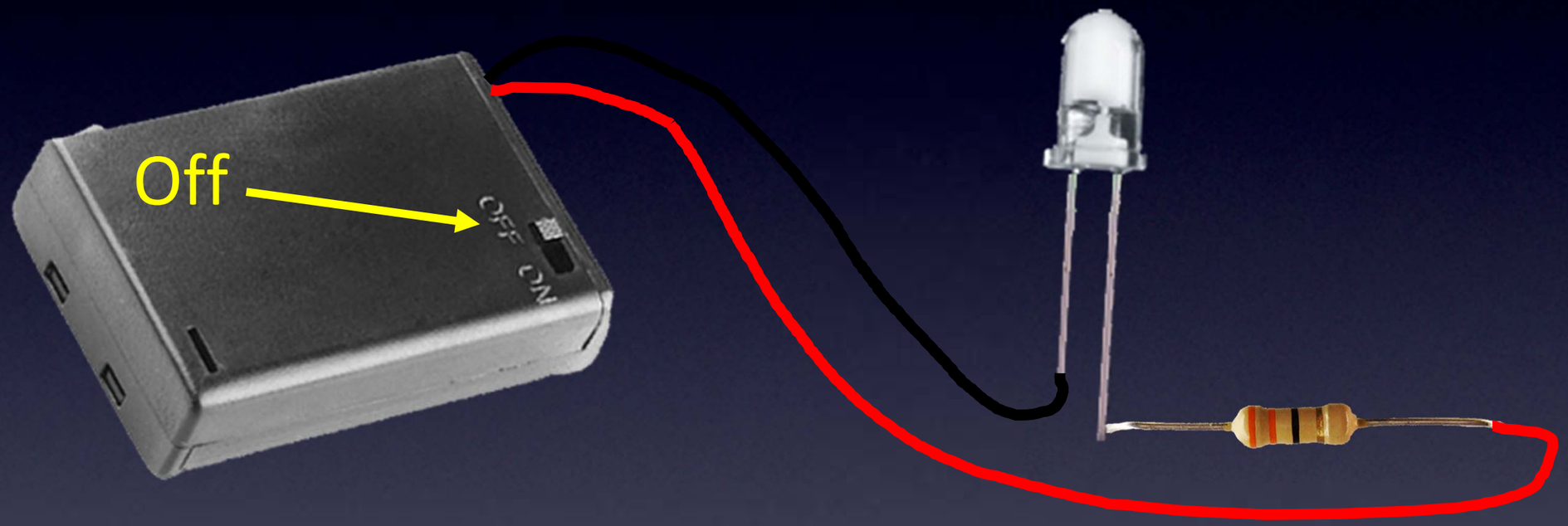
IR LED

Everything You Need to Know About Electronics



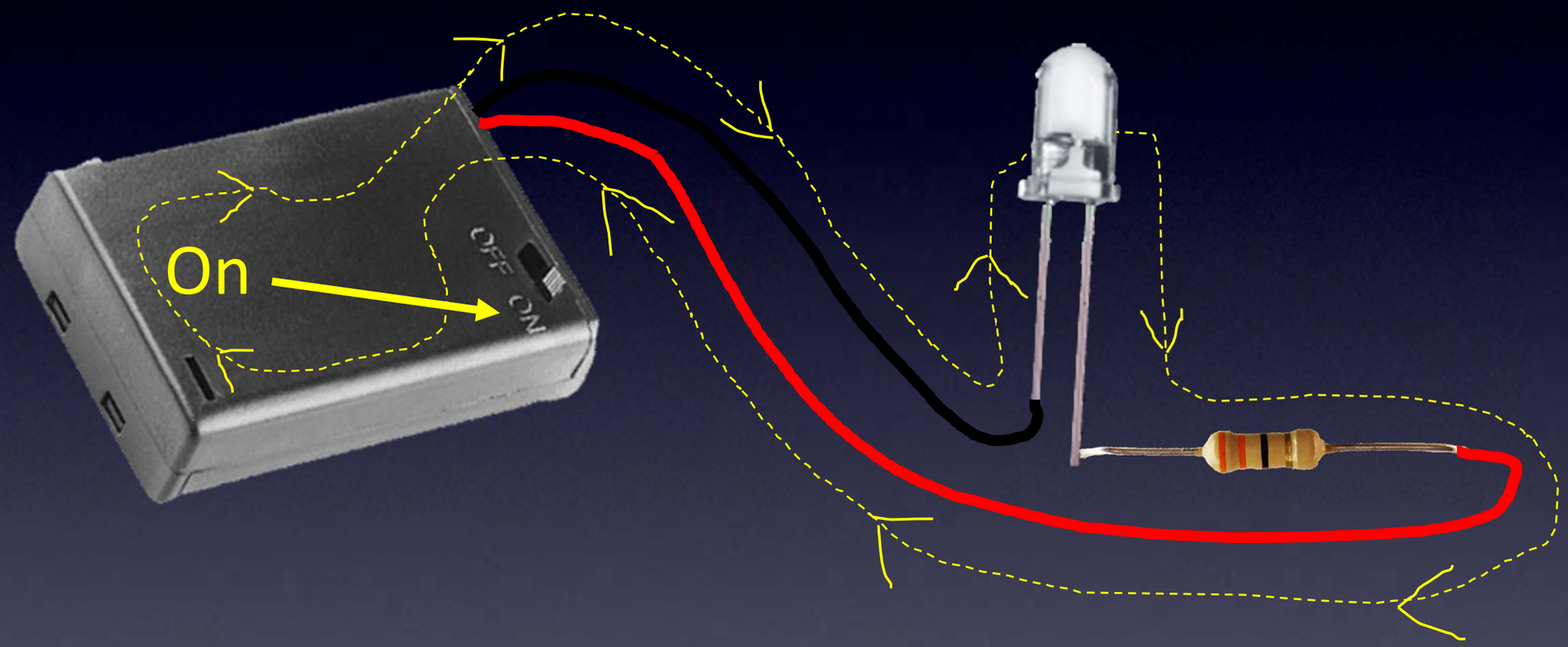
IR LED

Everything You Need to Know About Electronics



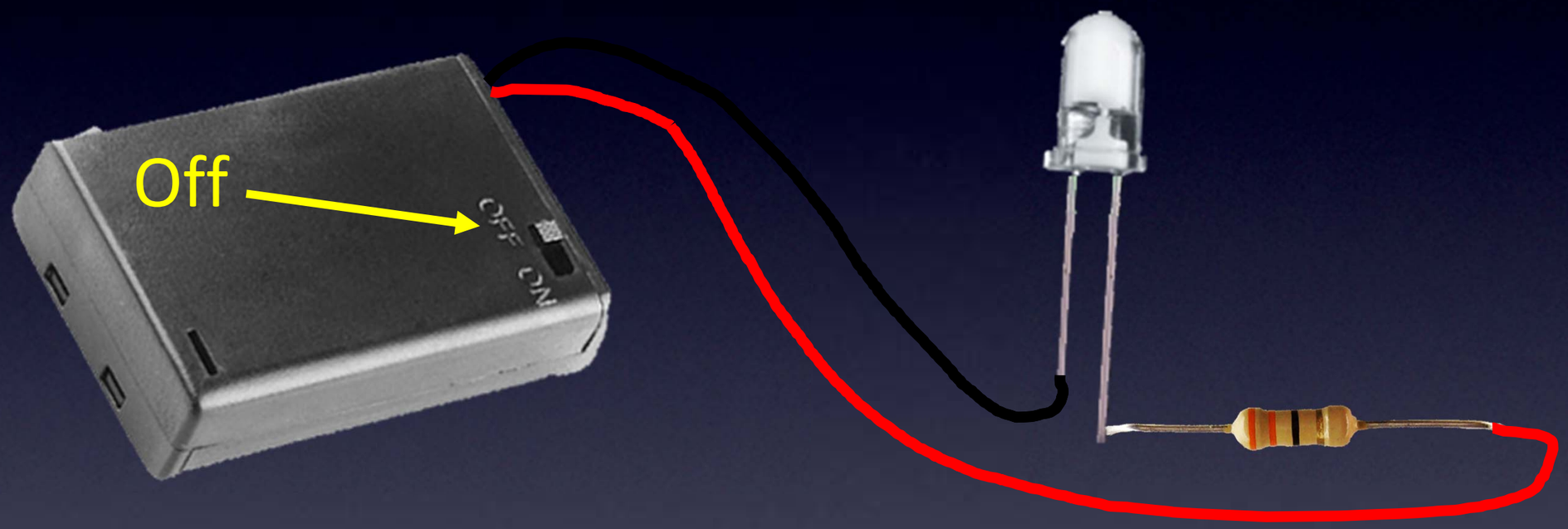
IR LED

Everything You Need to Know About Electronics



IR LED

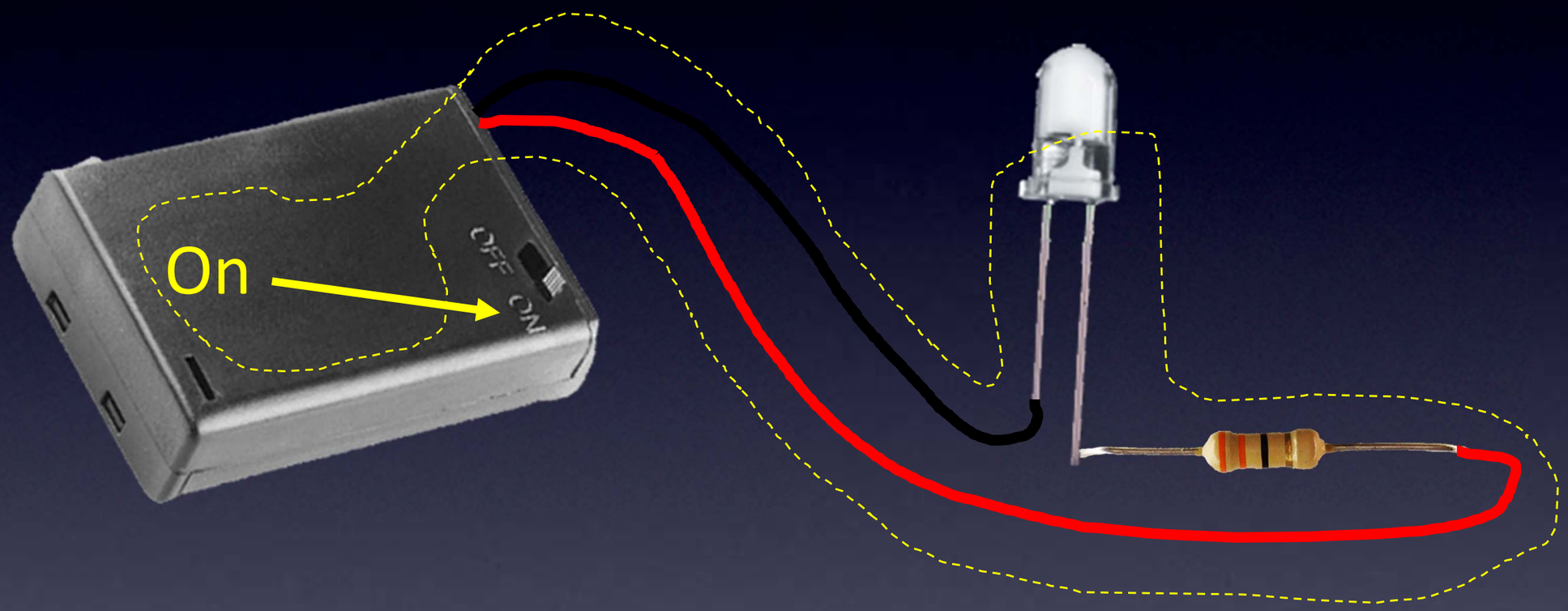
Everything You Need to Know About Electronics



A “code” is IR light blinking on-off-on-off…

IR Remote Control

Everything You Need to Know About Electronics



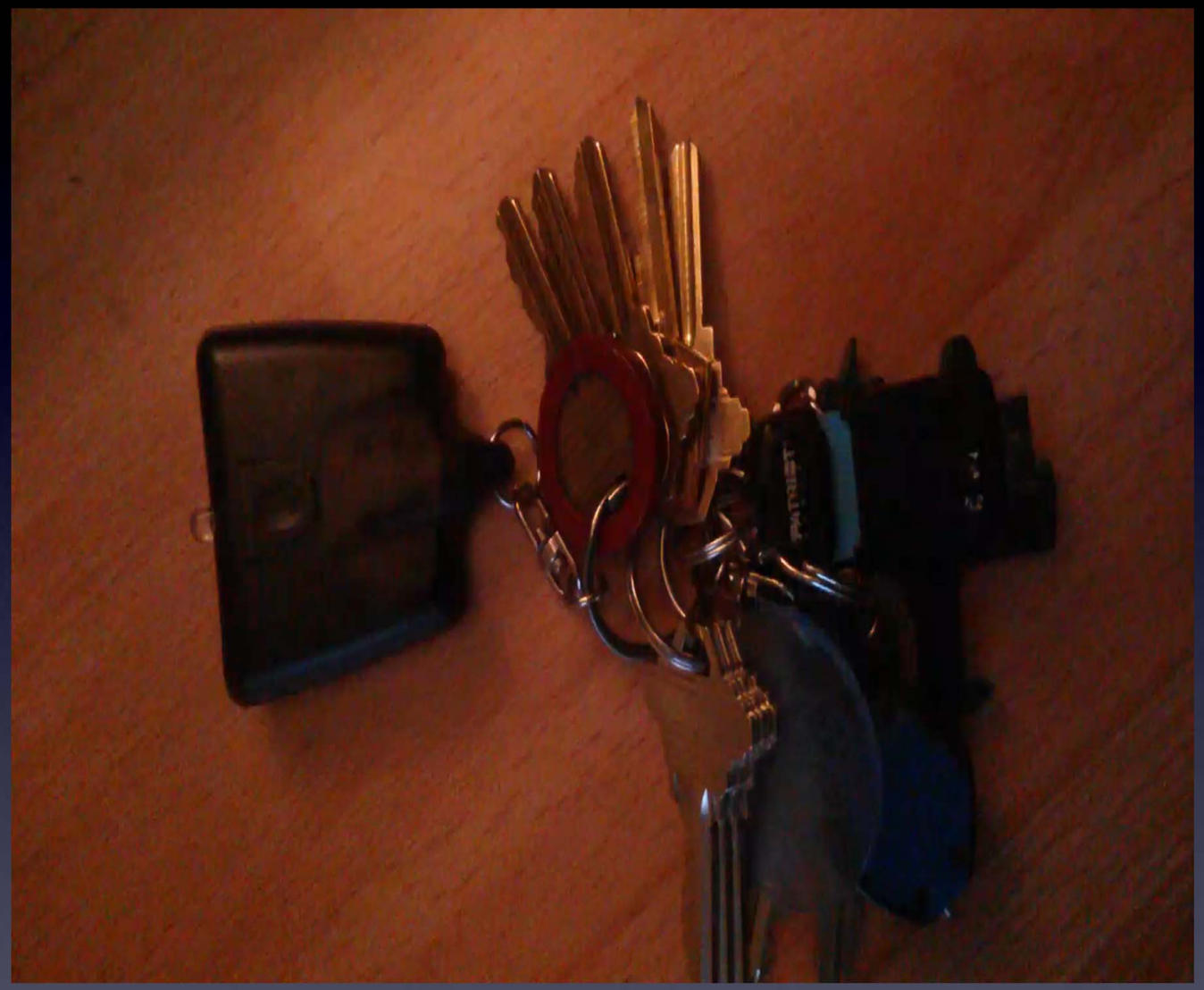
A “code” is IR light blinking on-off-on-off…

(we can’t do this, but microcontrollers can!)

IR Remote Control

Everything You Need to Know About Electronics

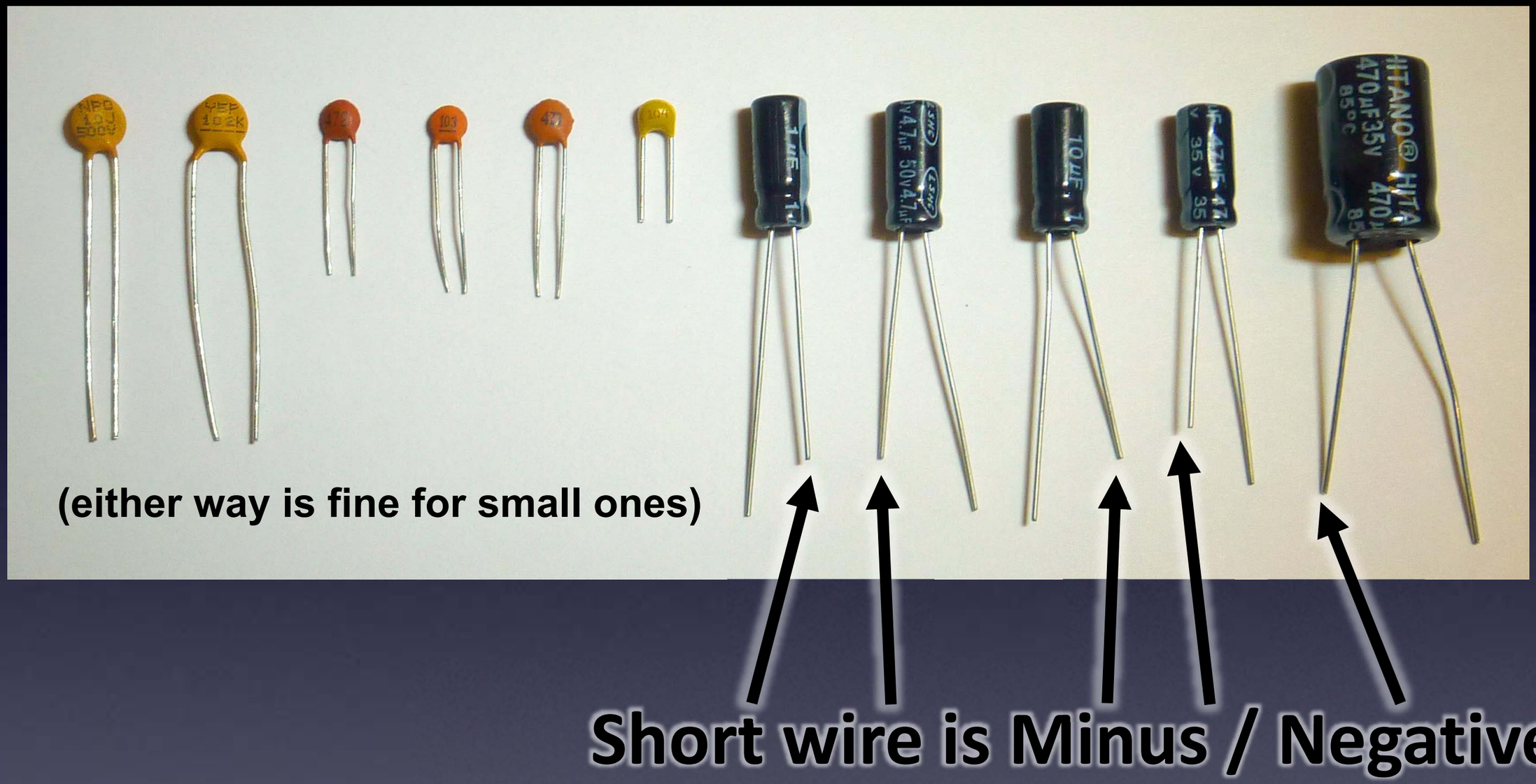
Takes about 60 seconds



About 150 IR “OFF” codes (one per blink)

TV-B-Gone universal remote control

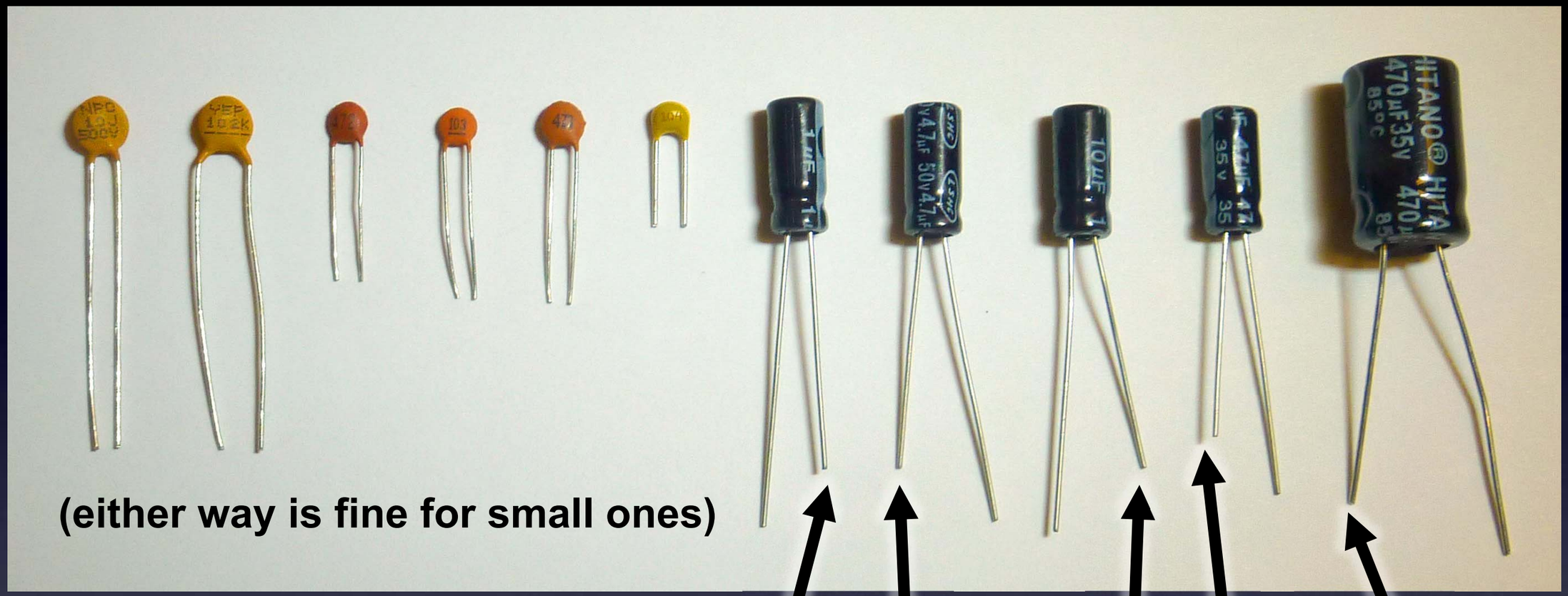
Everything You Need to Know About Electronics



Little buckets for electrons

Capacitor / Farads

Everything You Need to Know About Electronics

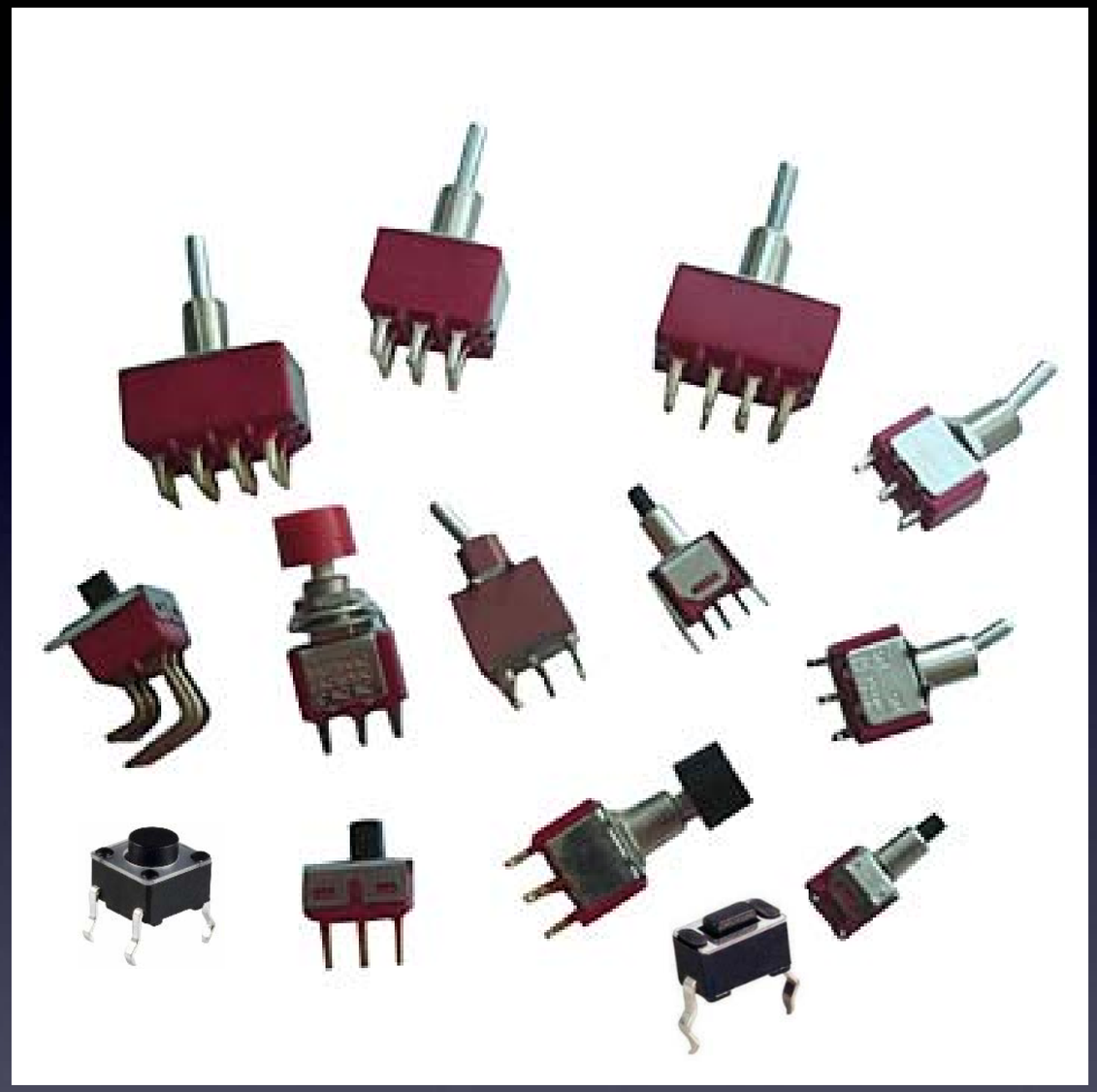


Short wire is Minus / Negative

Little buckets for electrons

Capacitor / **Farads**

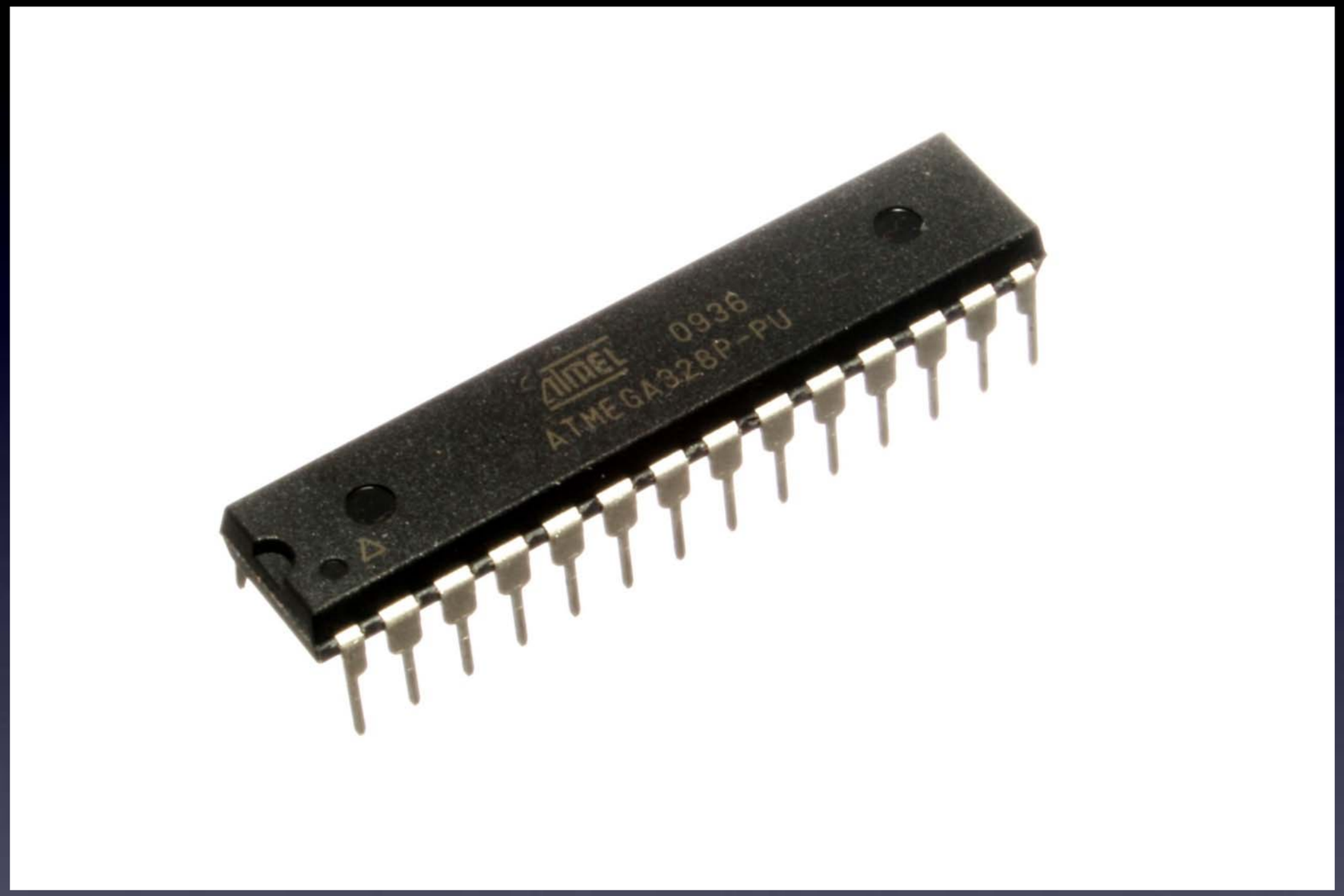
Everything You Need to Know About Electronics



Strips of metal connected together – or not

Switch

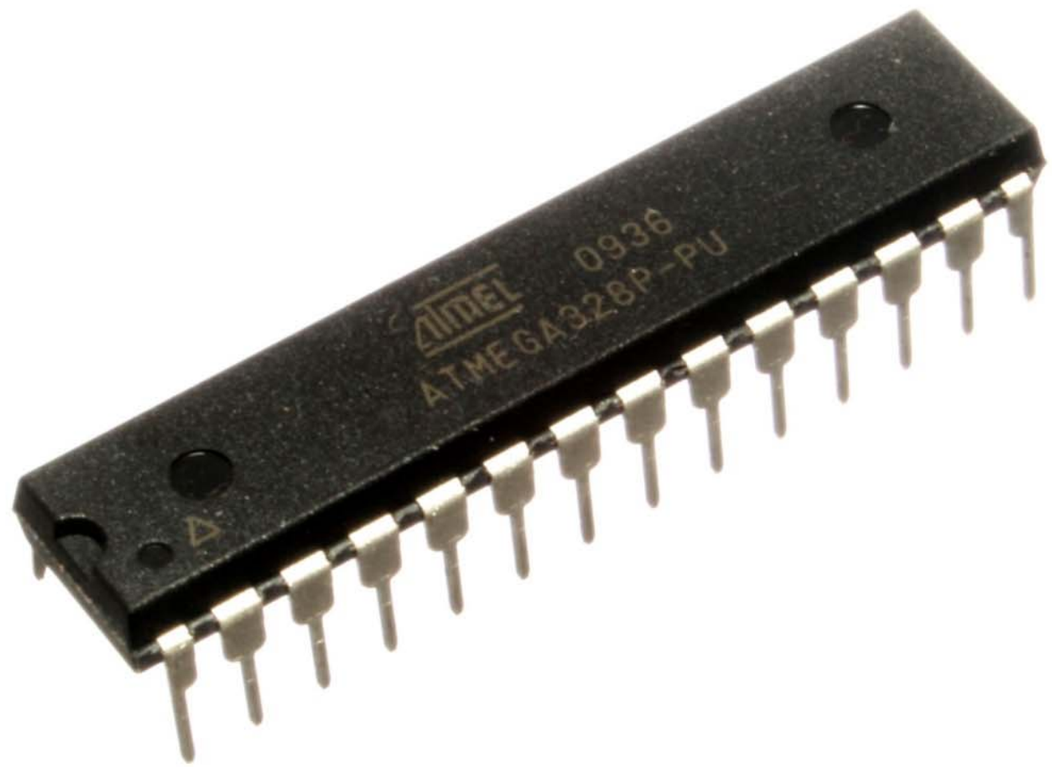
Everything You Need to Know About Electronics



A complete computer on a chip

Microcontroller

Everything You Need to Know About Electronics



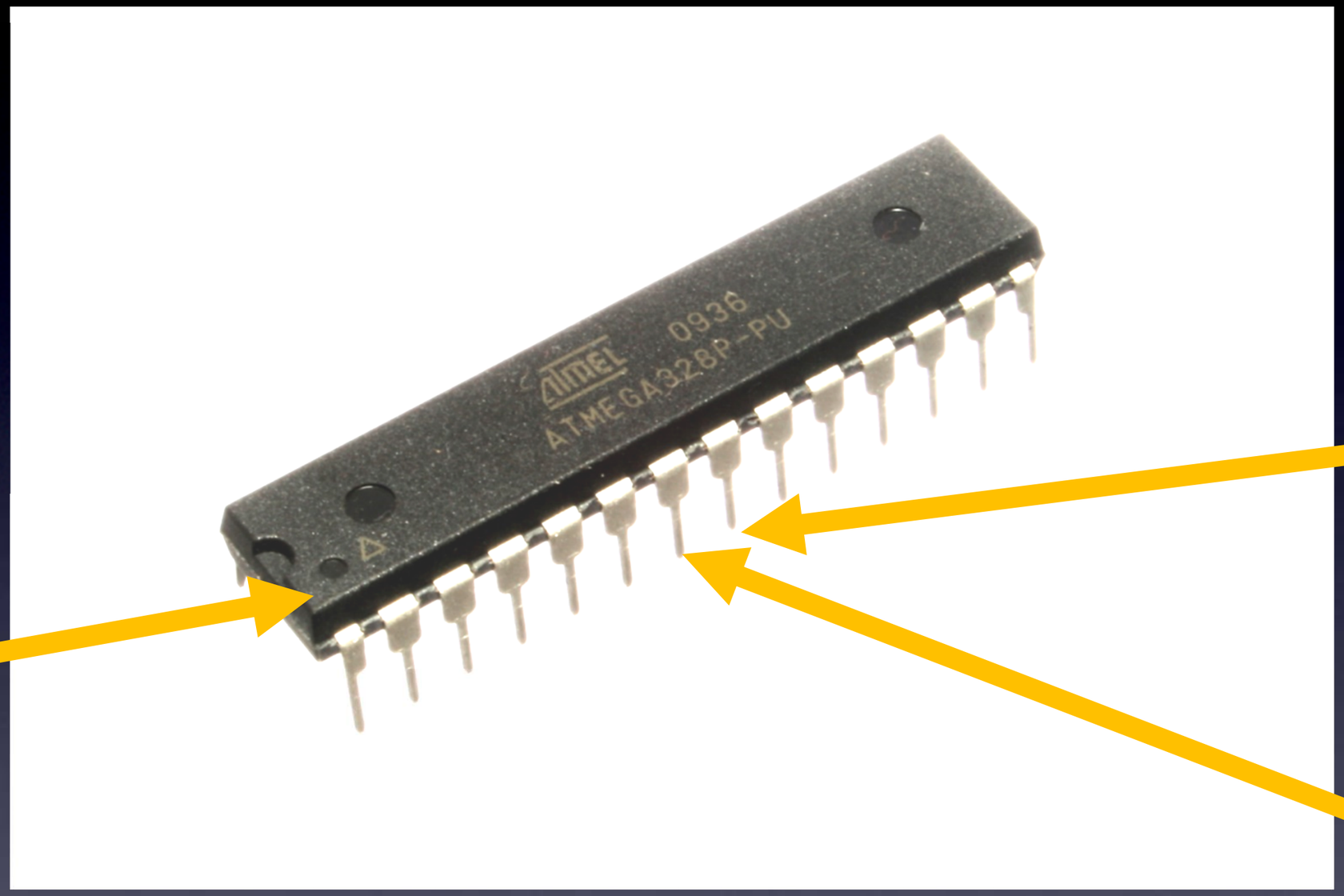
It runs programs

that control electronic parts connected to its pins.

Microcontroller

Everything You Need to Know About Electronics

2 special pins:



Pin 1

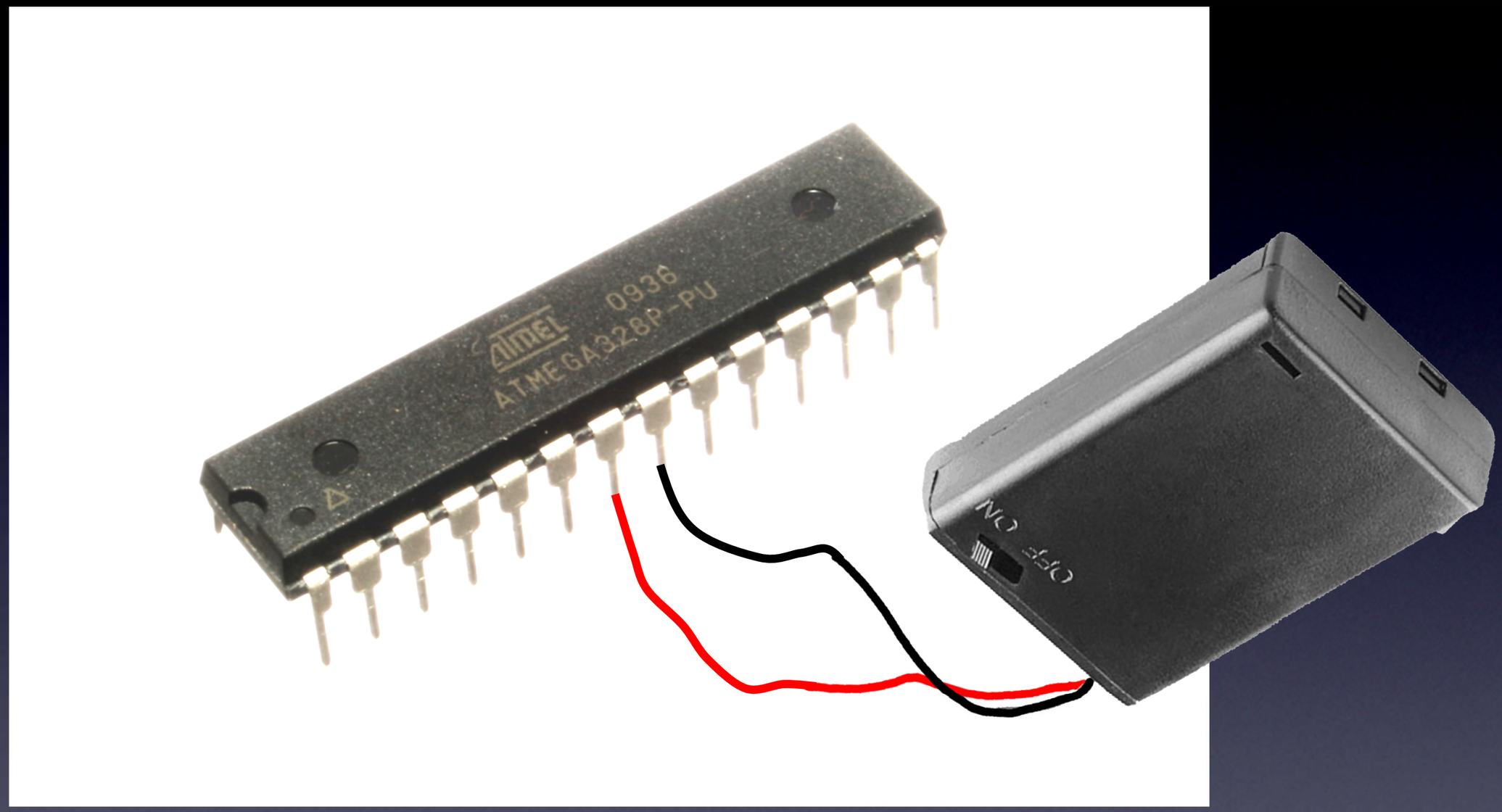
Pin 8 = Ground

Pin 7 = Vcc

A complete computer on a chip

Microcontroller – it matters how you hook it up!

Everything You Need to Know About Electronics

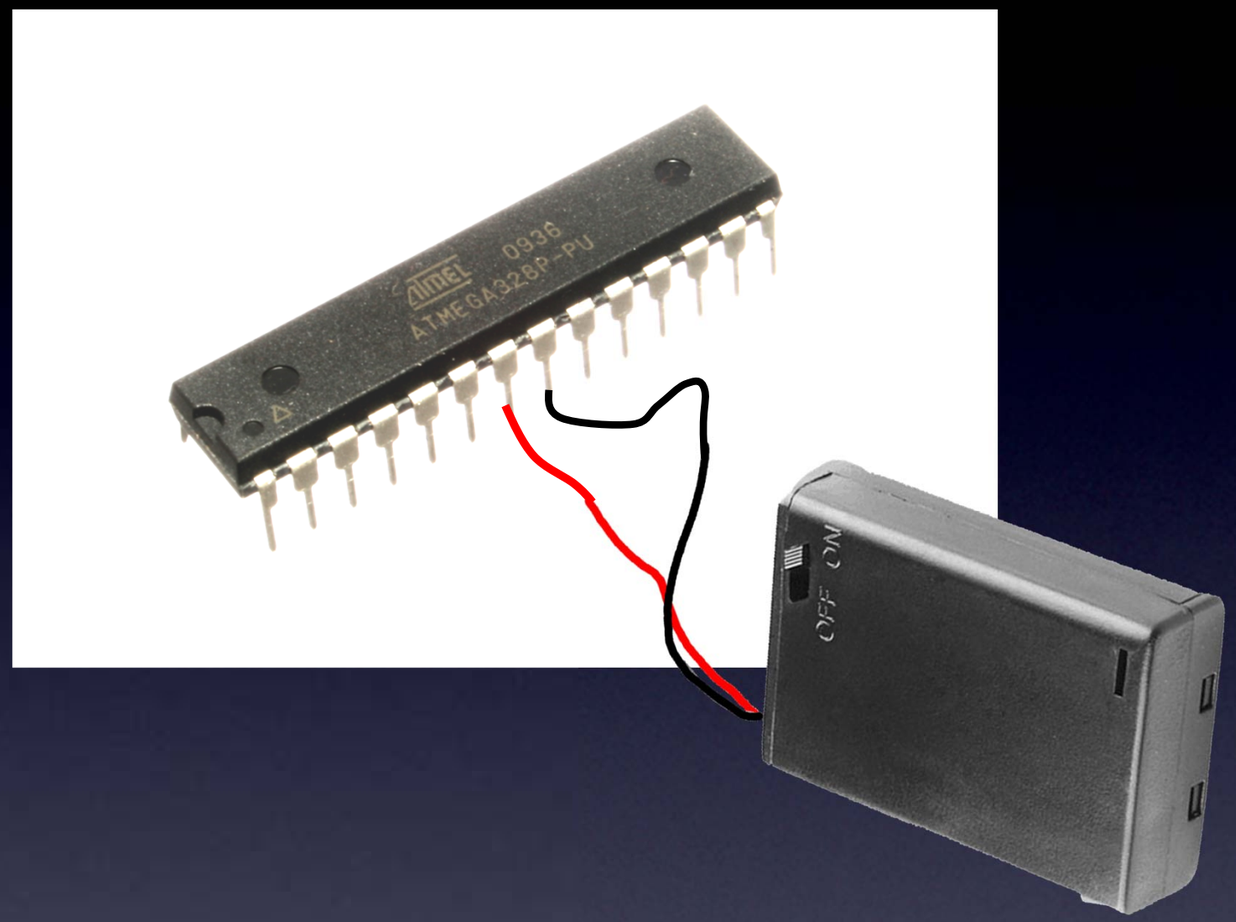


A complete computer – running a program!

Microcontroller – turned on!

Everything You Need to Know About Electronics

all other pins are
Input pins
or
Output pins



Your program controls electronics parts
on these other pins

Microcontroller

Everything You Need to Know About Electronics

Analog Electronics:

Any voltage between Ground (0V) and Vcc

Digital Electronics:

Only 2 choices: Ground (0V) or Vcc

2 types of electronics

Everything You Need to Know About Electronics

Ground (0V)	Power / Vcc
Low	High
Off	On
0	1

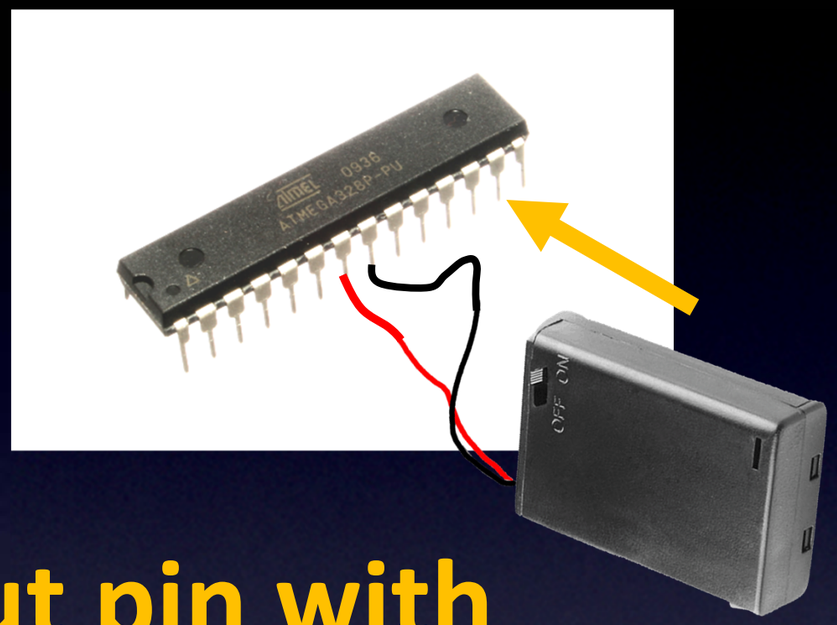
(without Voltage / with Voltage)
(without current / with current)

Digital Electronics:

Only 2 choices: Ground (0V) or Vcc

Digital Electronics

Everything You Need to Know About Electronics



To make a pin an
Output pin

you tell it to become an Output pin with a statement in your program

Let’s tell pin 13 to be an Output pin

Microcontroller – Output pins

Everything You Need to Know About Electronics

Low **High**

Off **On**

(0V) (Power supply voltage)

-- like the Red wire of our power supply

-- but controlled by our program!

Only 2 choices: High or Low

Microcontroller – Output pins

A real world example

How to make an LED blink?

`Hello World`

Microcontroller

Everything You Need to Know About Electronics

Software

Type:

Hello World

on your screen

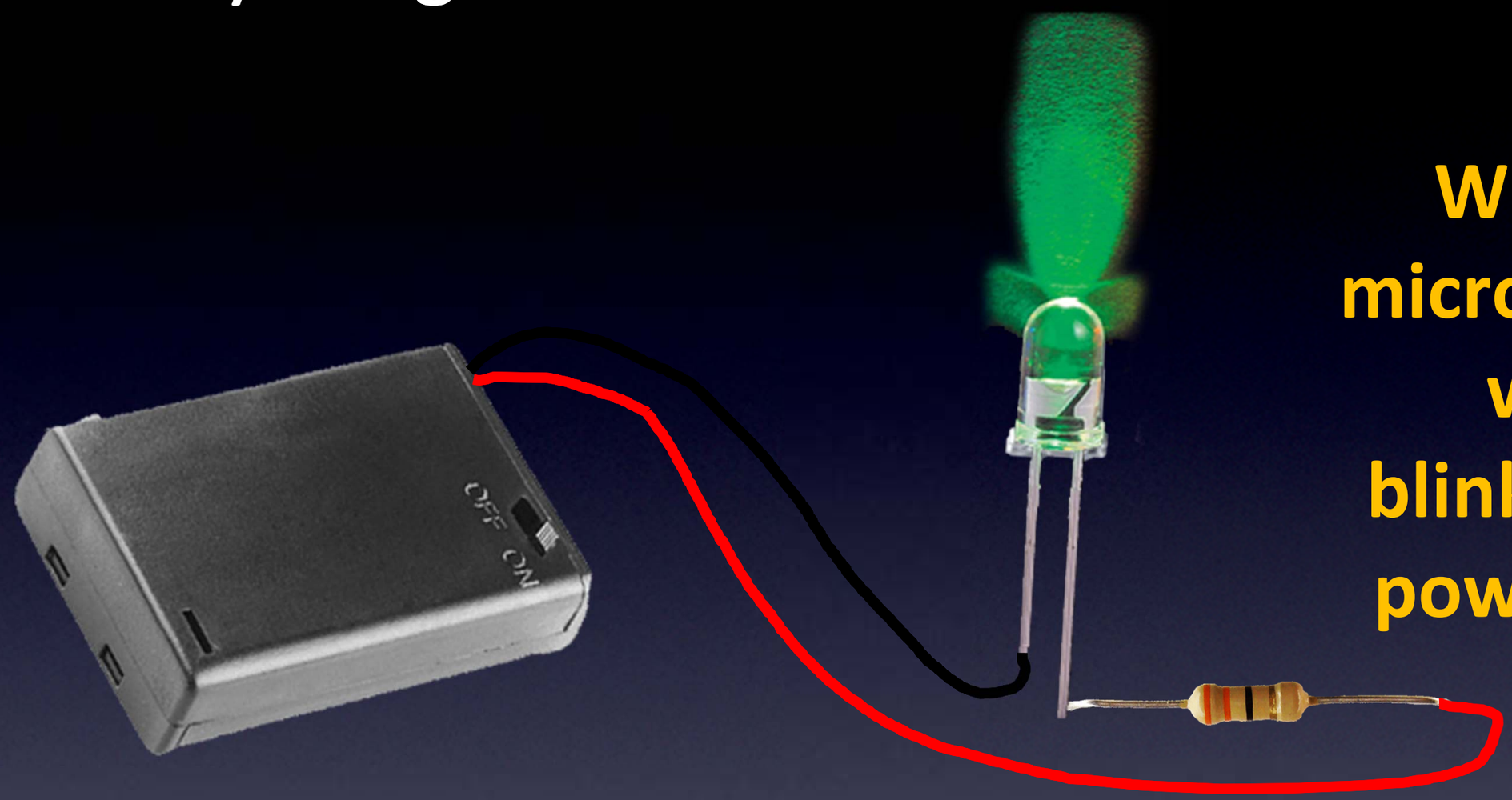
Microcontrollers

make an LED blink

Hello World

Microcontroller

Everything You Need to Know About Electronics



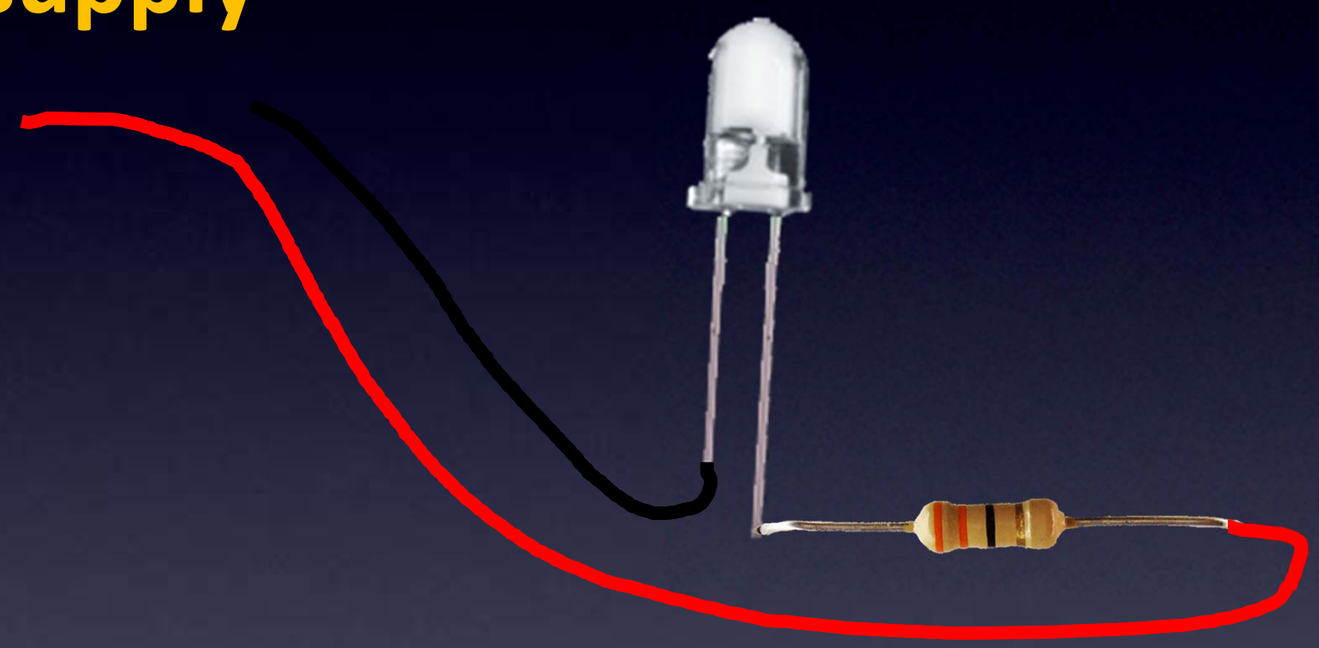
Without a microcontroller we can blink with our power supply

Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

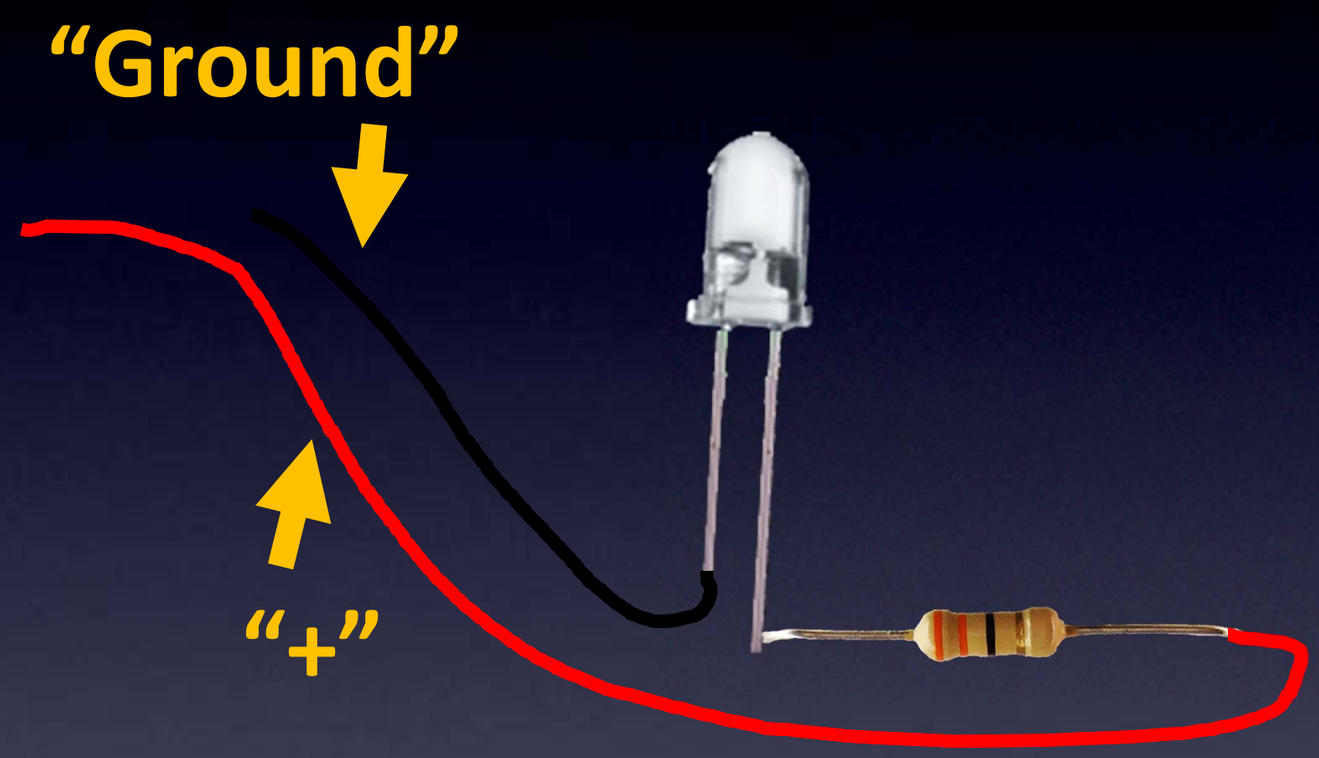
Let's replace the power supply



Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics



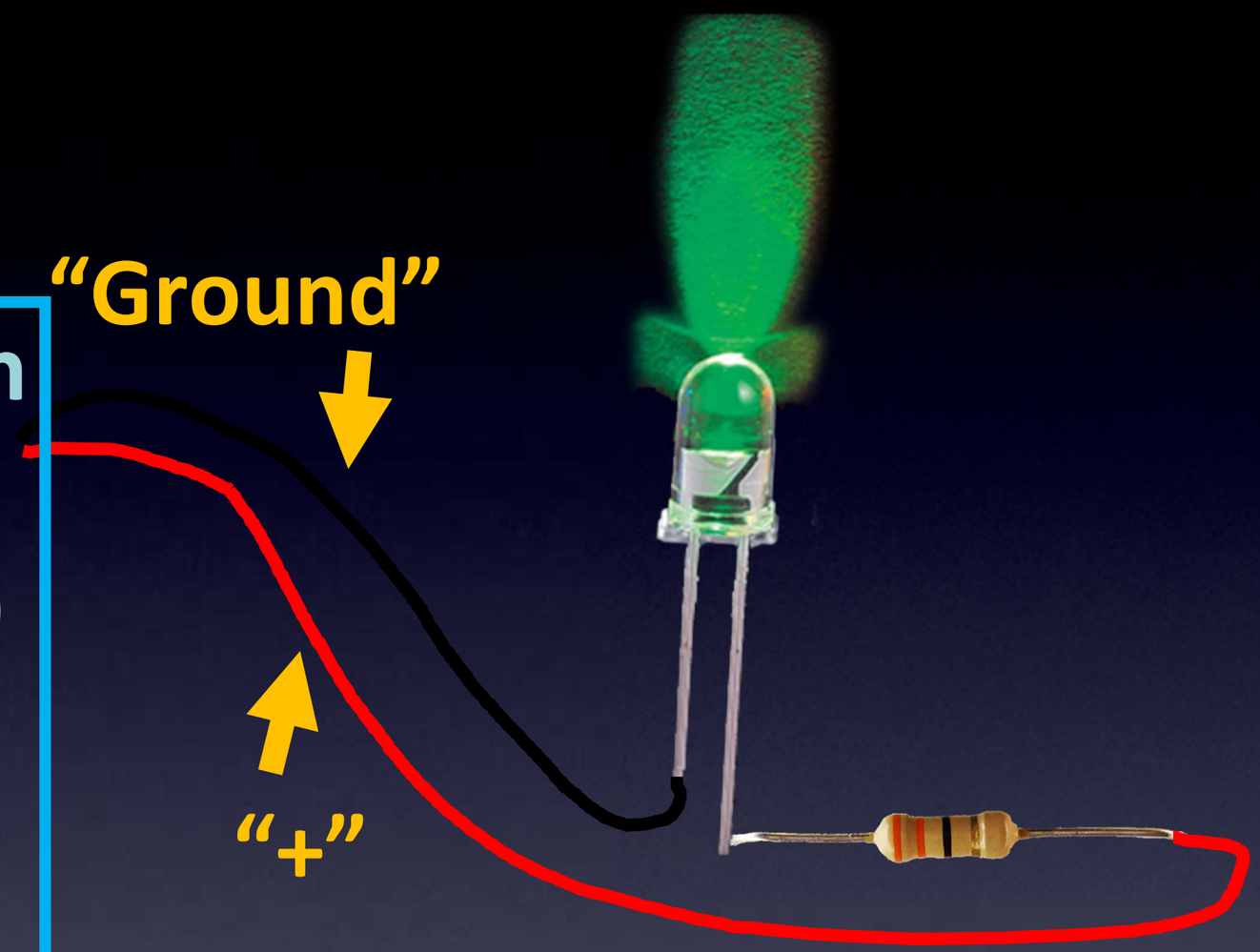
Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

We can use an Output pin (and Ground)

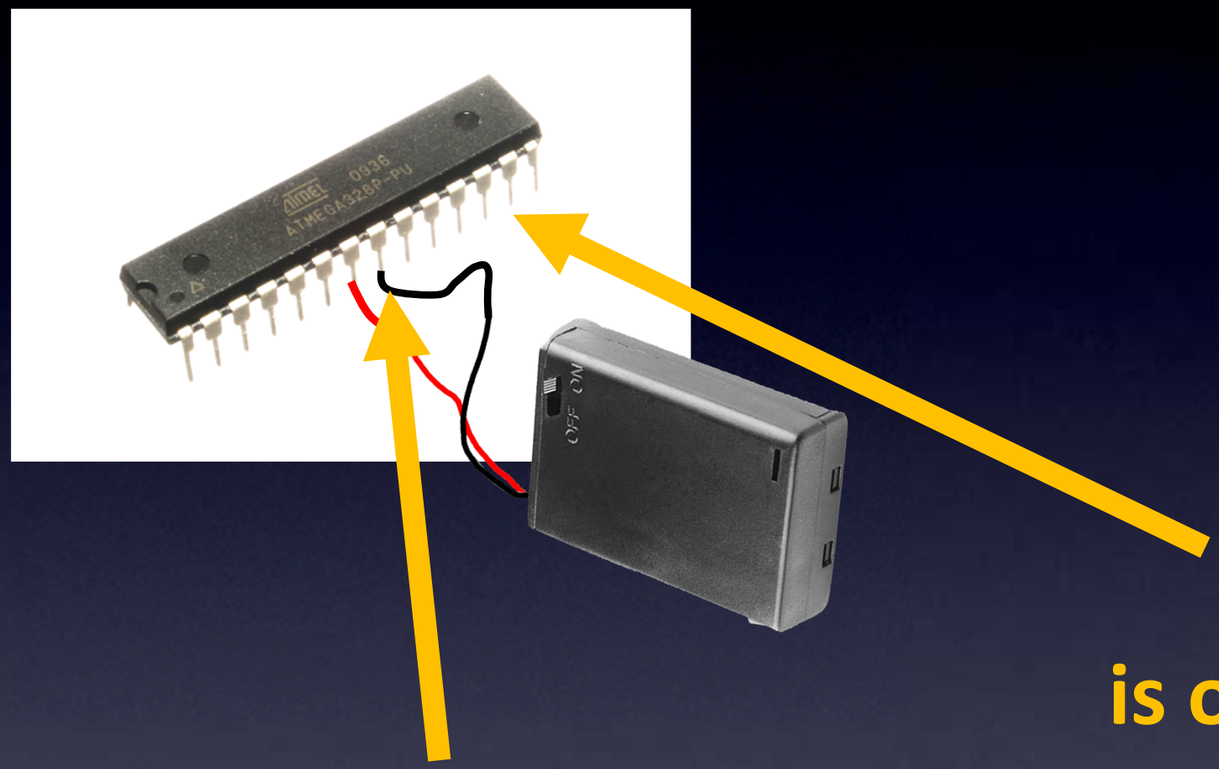
as our power supply



Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics



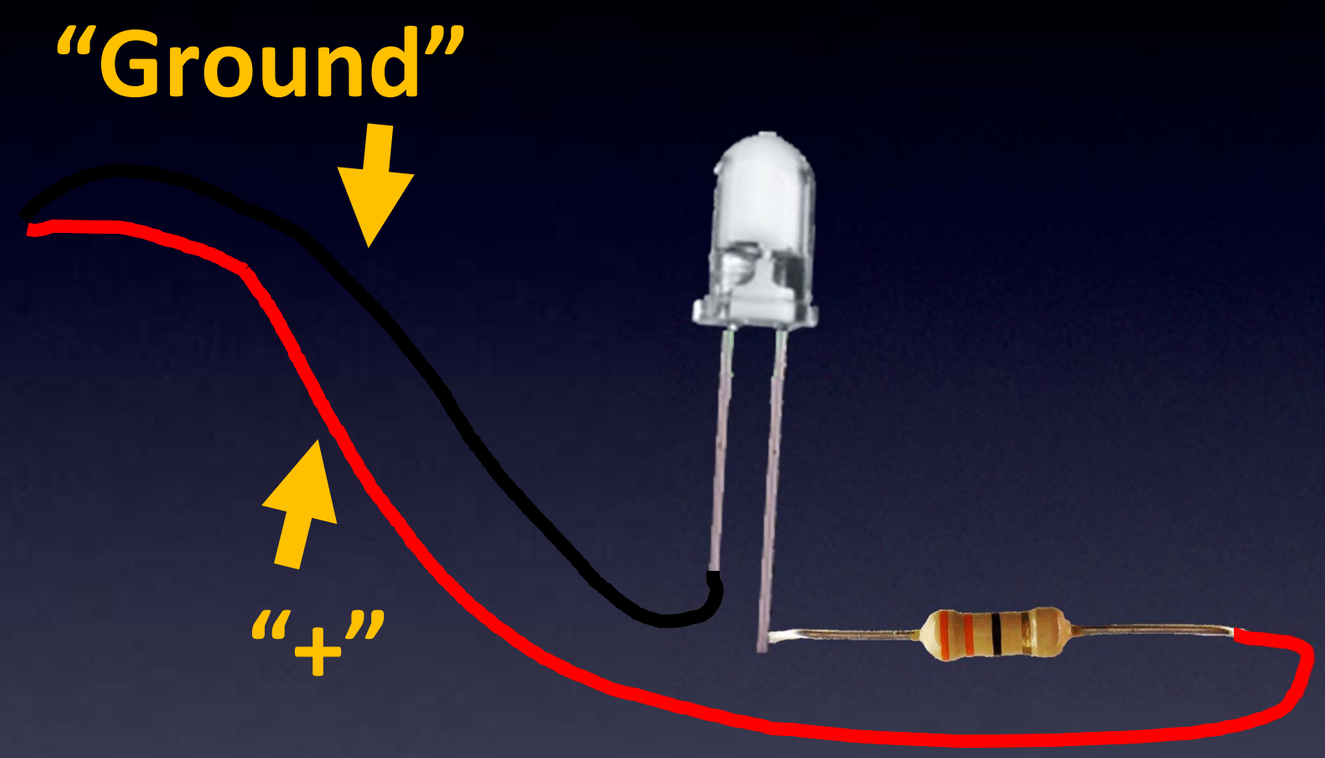
Ground

Pin 13
is our Output pin
(which can be On or Off)

Turning an LED on and off

(Leading up to `Hello World`)

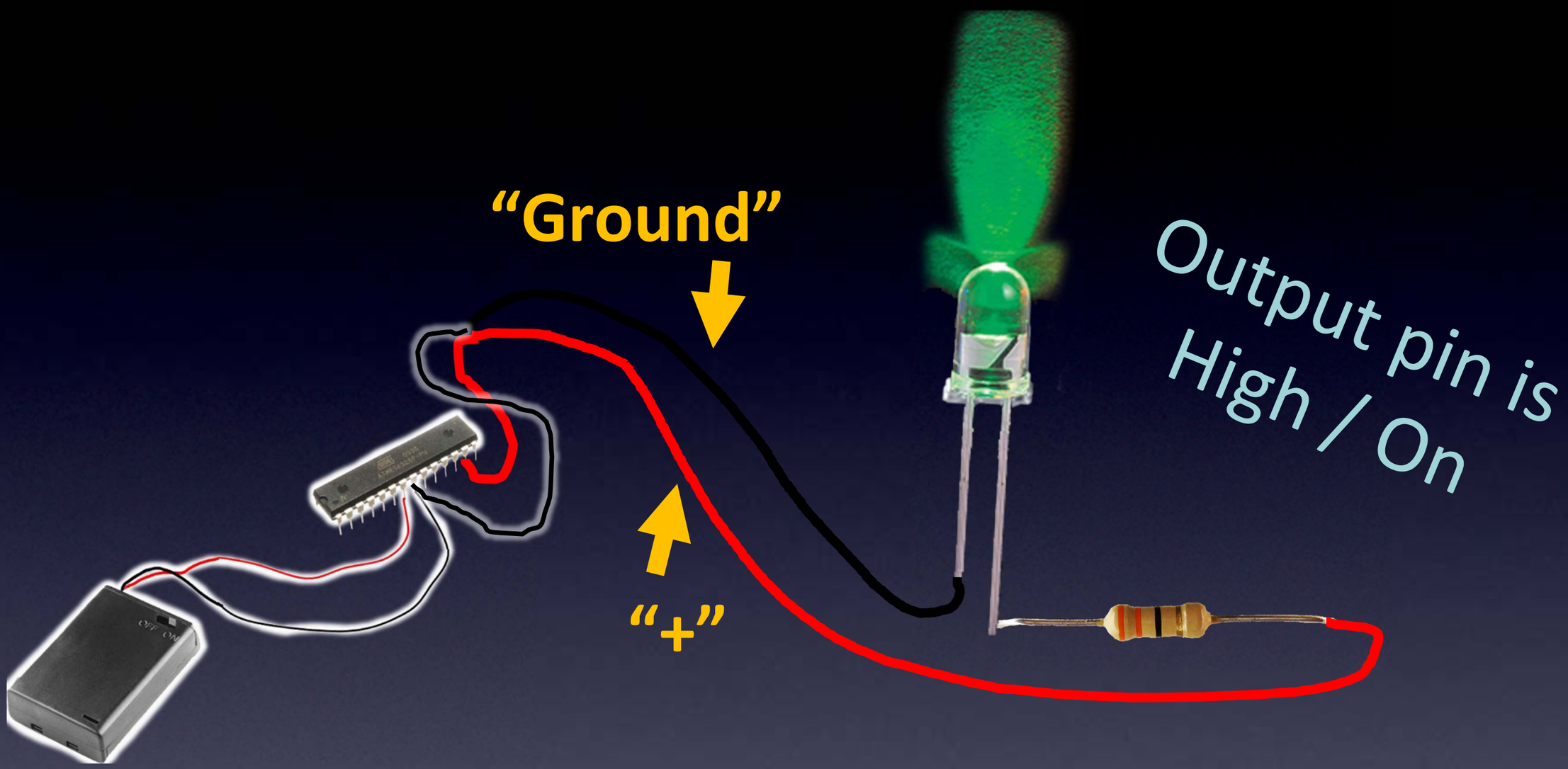
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

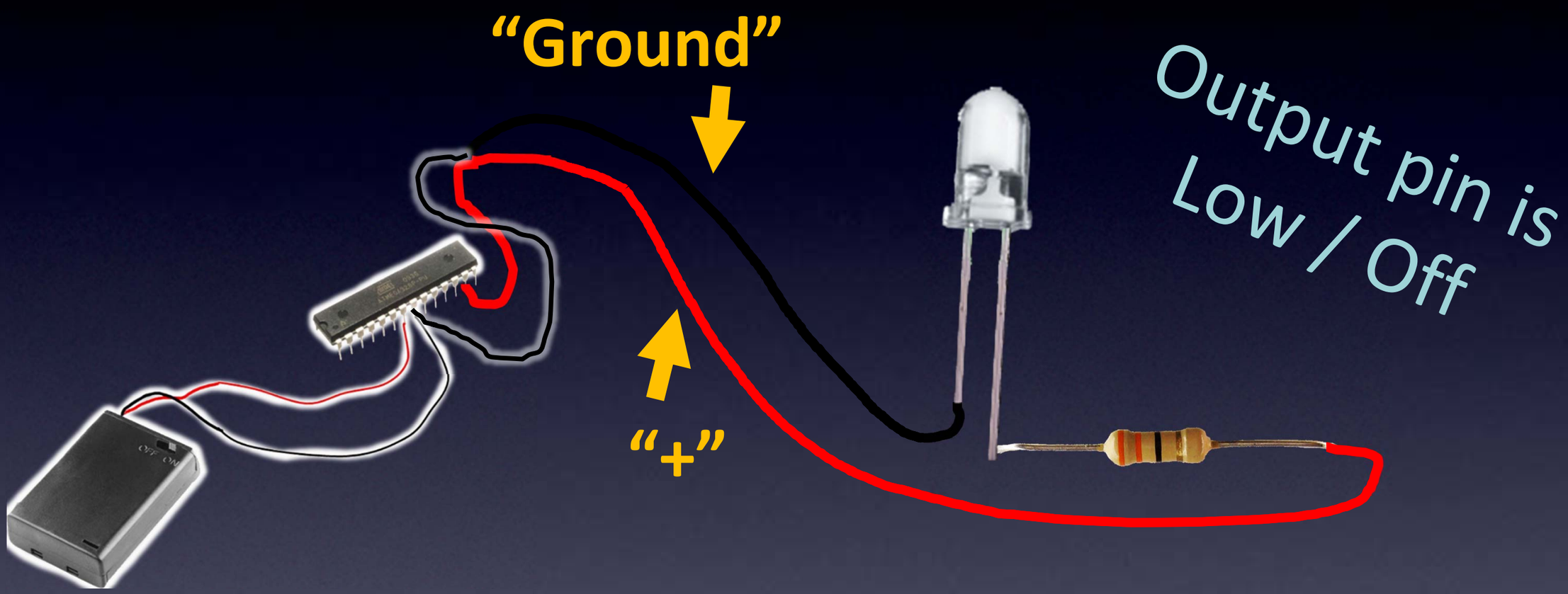
What You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

What You Need to Know About Electronics

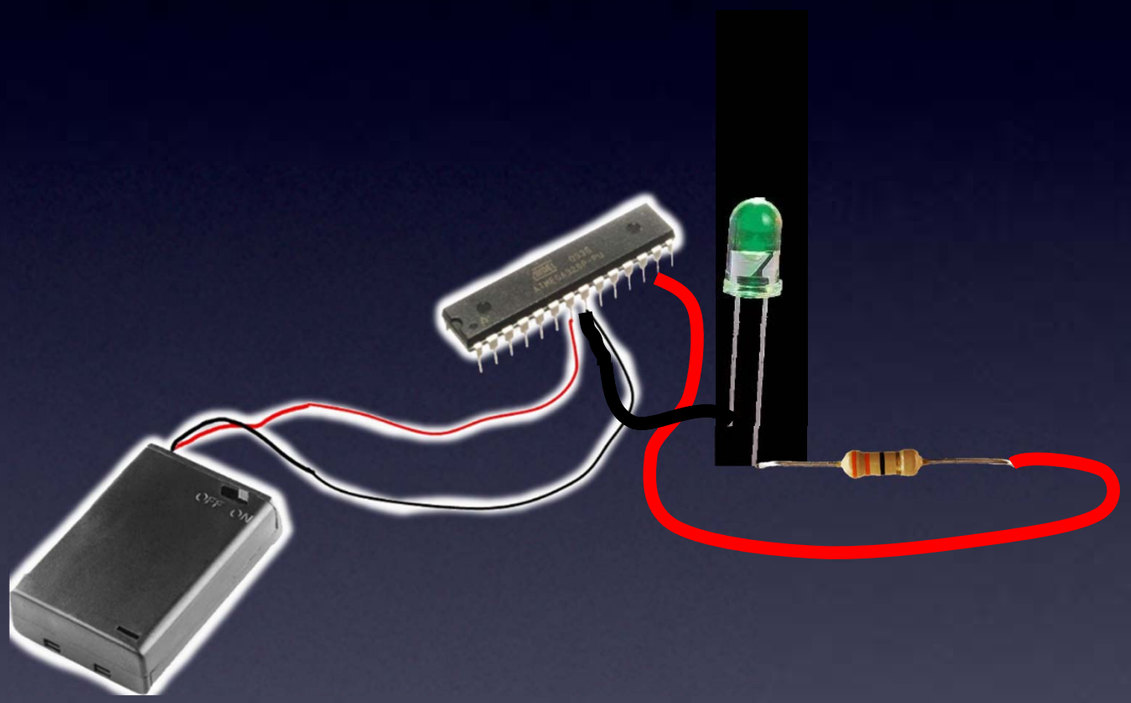


Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

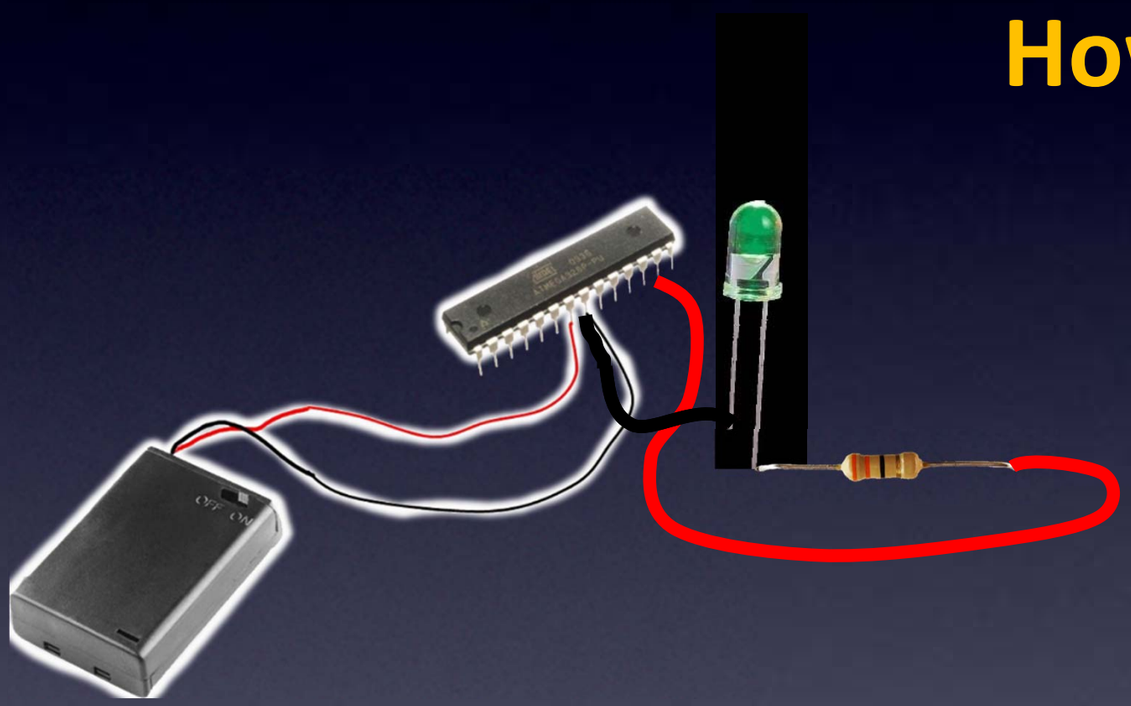
This is our **Hardware** for `Hello World!`



Turning an LED on and off

`Hello World`

Everything You Need to Know About Electronics



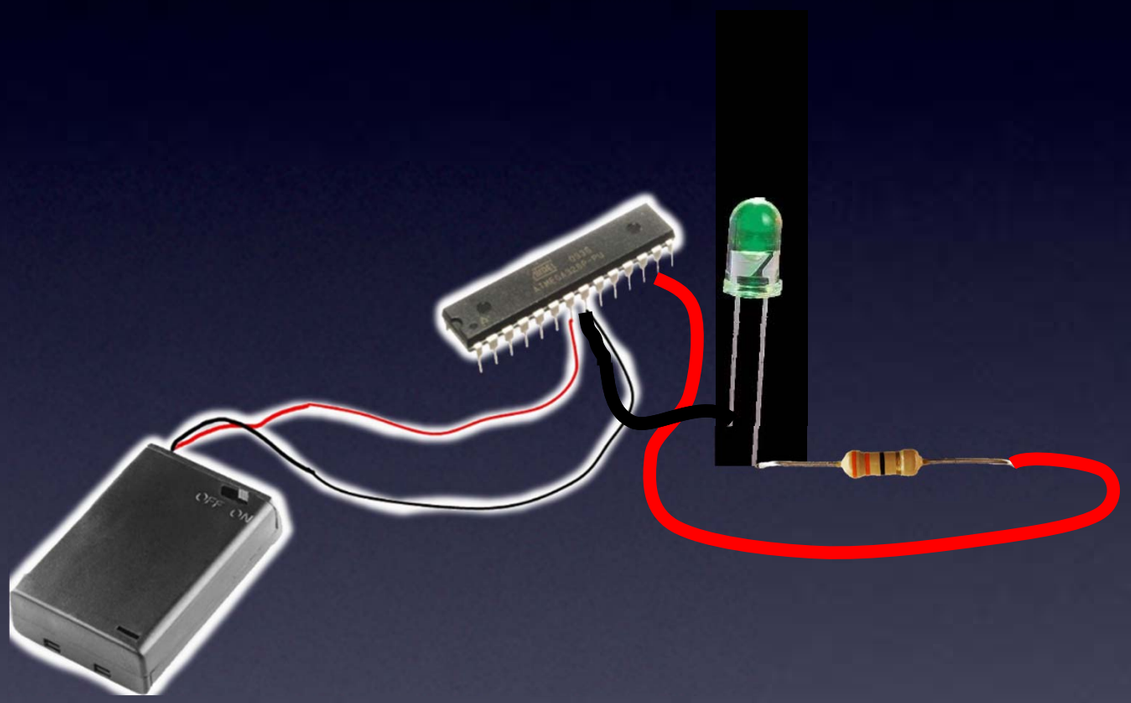
How about our program?

Turning an LED on and off

```
Hello World
```

Everything You Need to Know About Electronics

Programs on microcontrollers are called "Firmware"

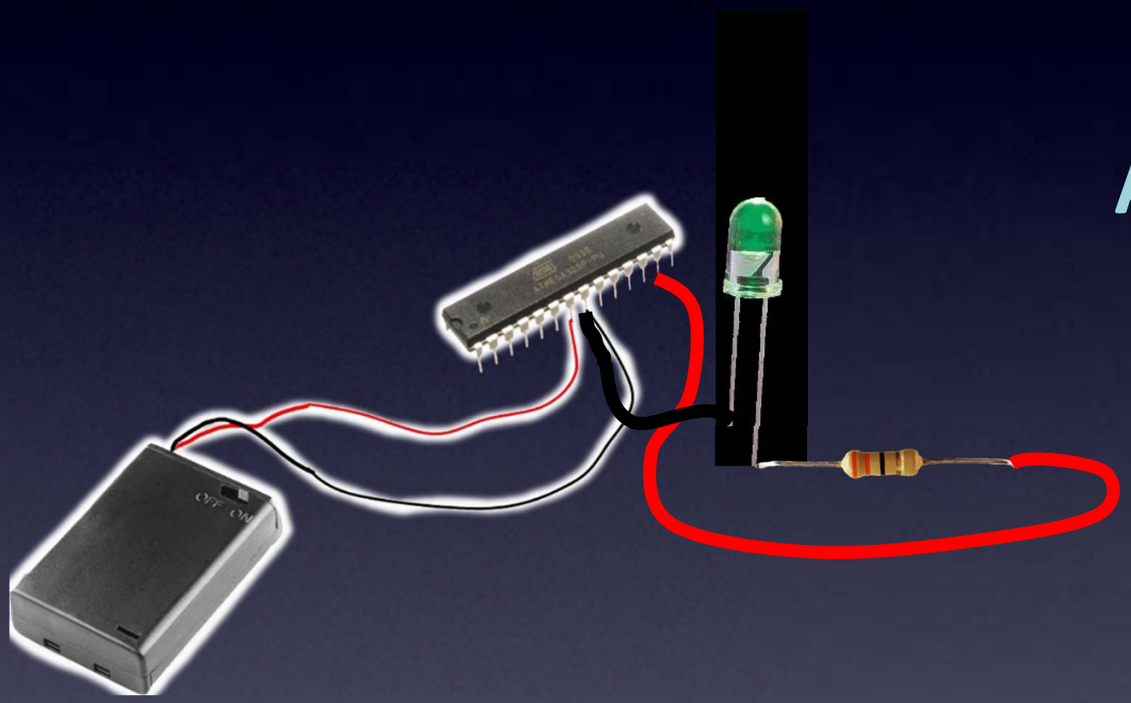


Turning an LED on and off

```
Hello World
```

What You Need to Know About Electronics

Programs on microcontrollers are called "Firmware"



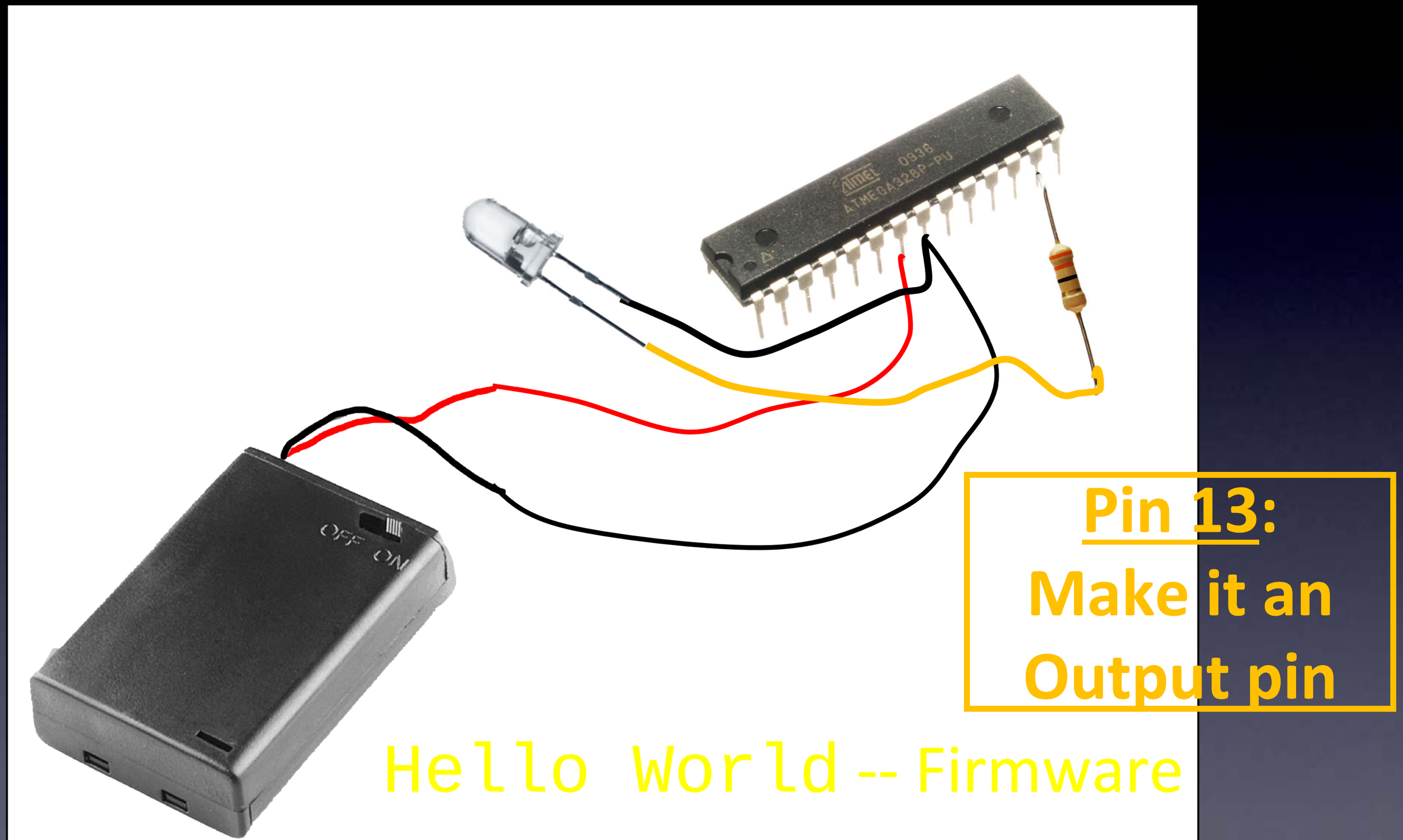
A programs for Arduino is called a

"Sketch"

Turning an LED on and off

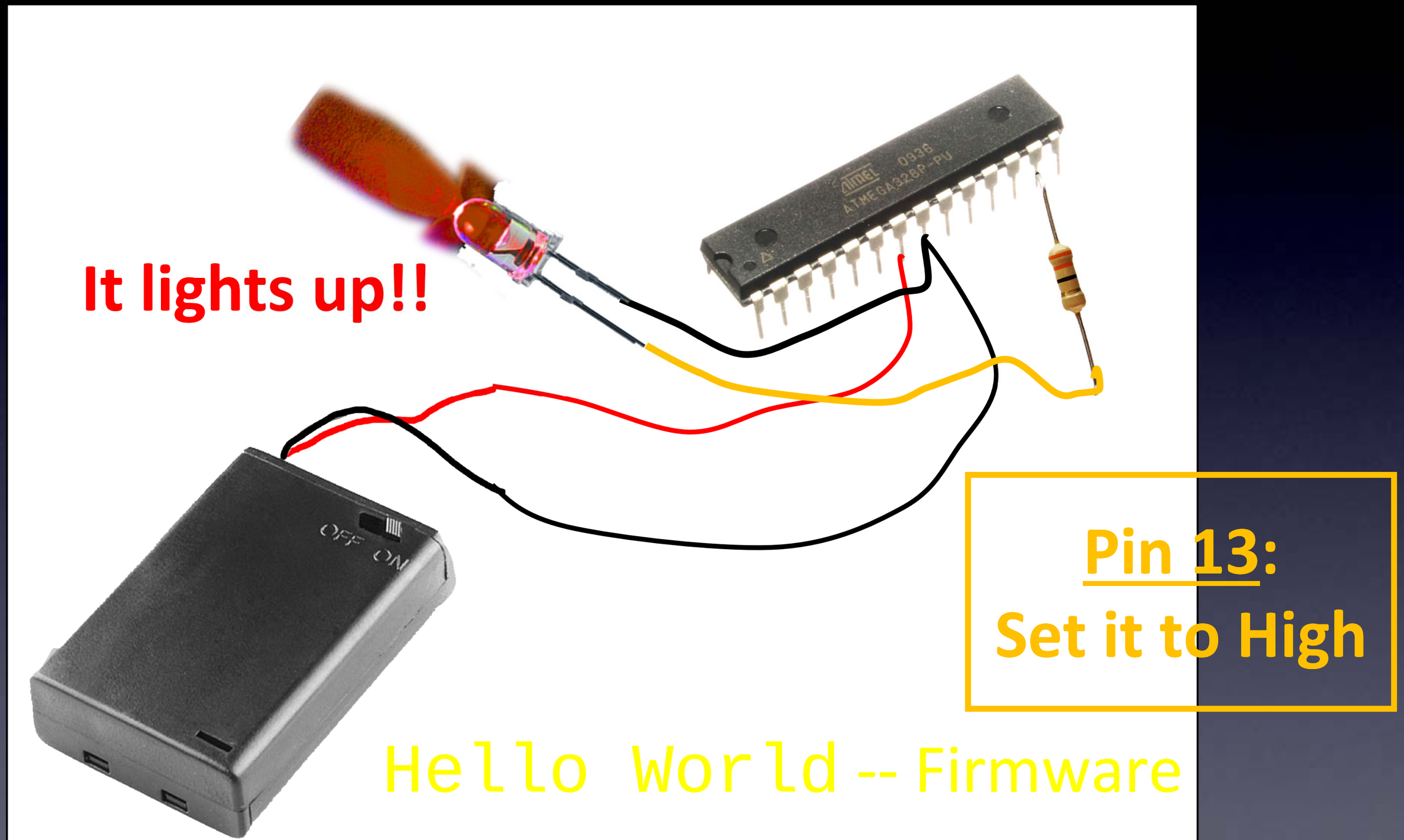
```
Hello World
```

Everything You Need to Know About Electronics



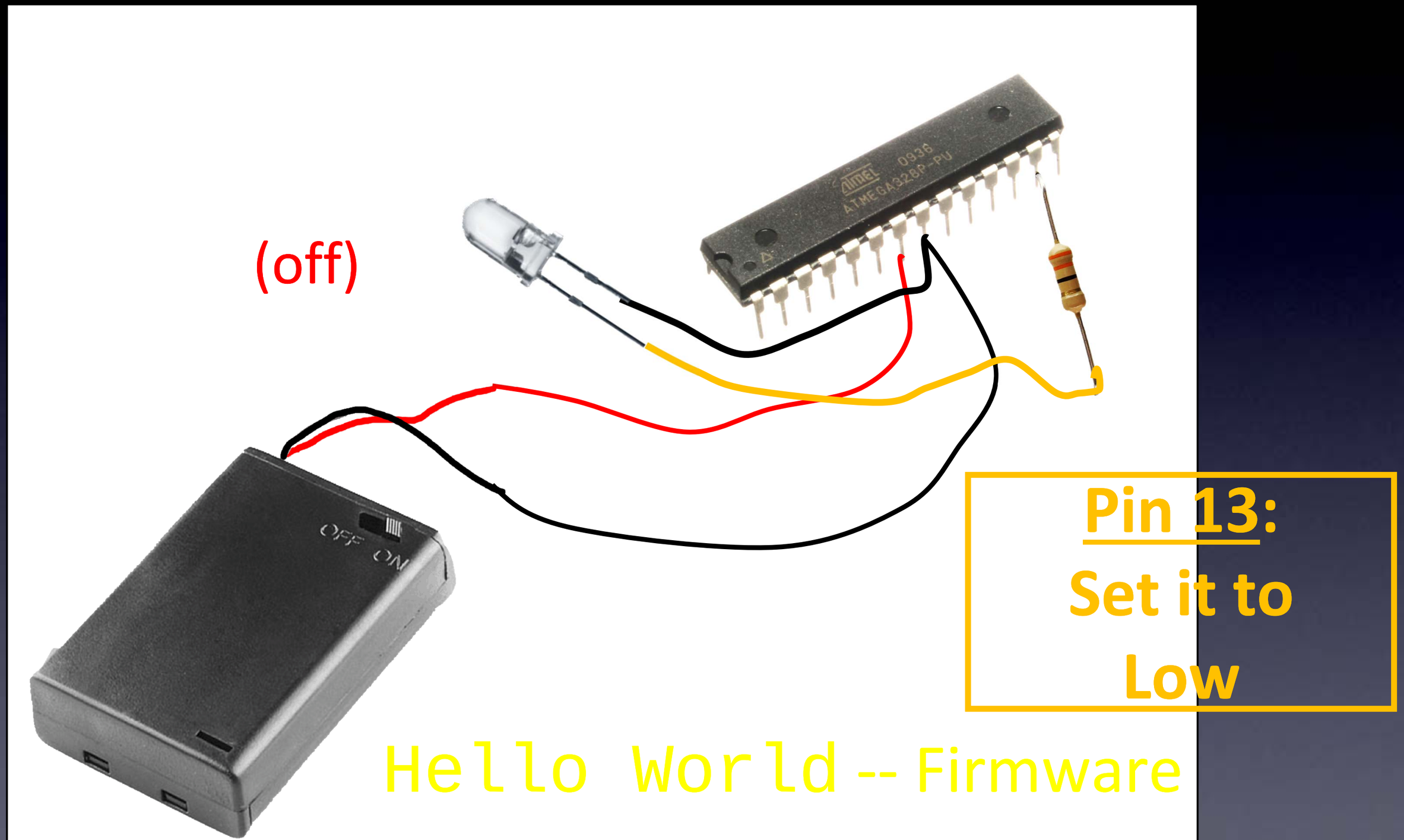
Microcontroller

Everything You Need to Know About Electronics



Microcontroller

Everything You Need to Know About Electronics



Microcontroller

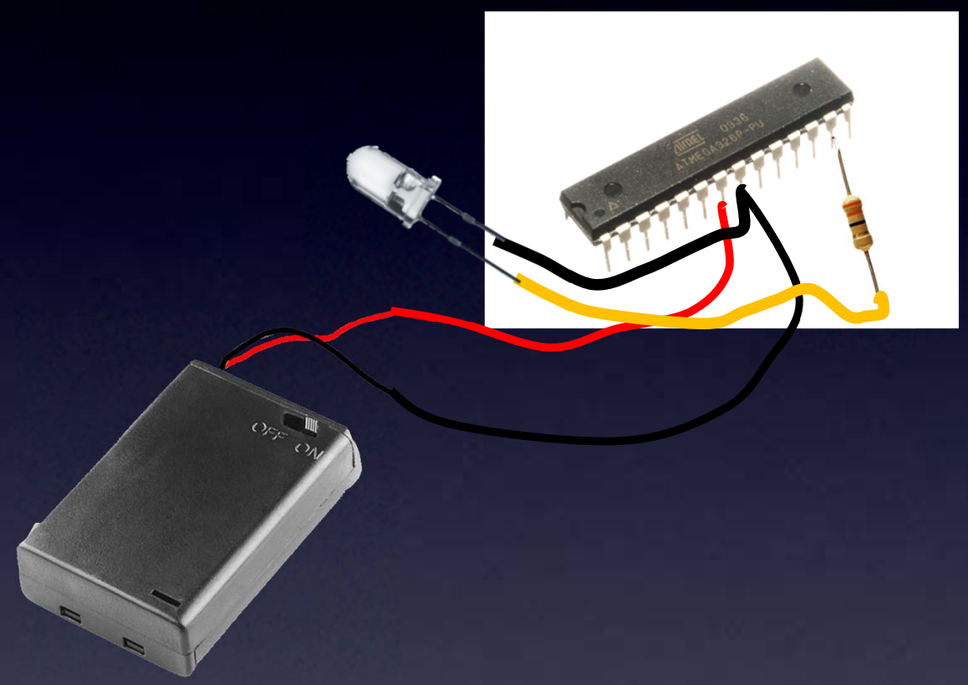
Everything You Need to Know About Electronics

We now have

`Hello World !`

Microcontroller

Everything You Need to Know About Electronics



We now have

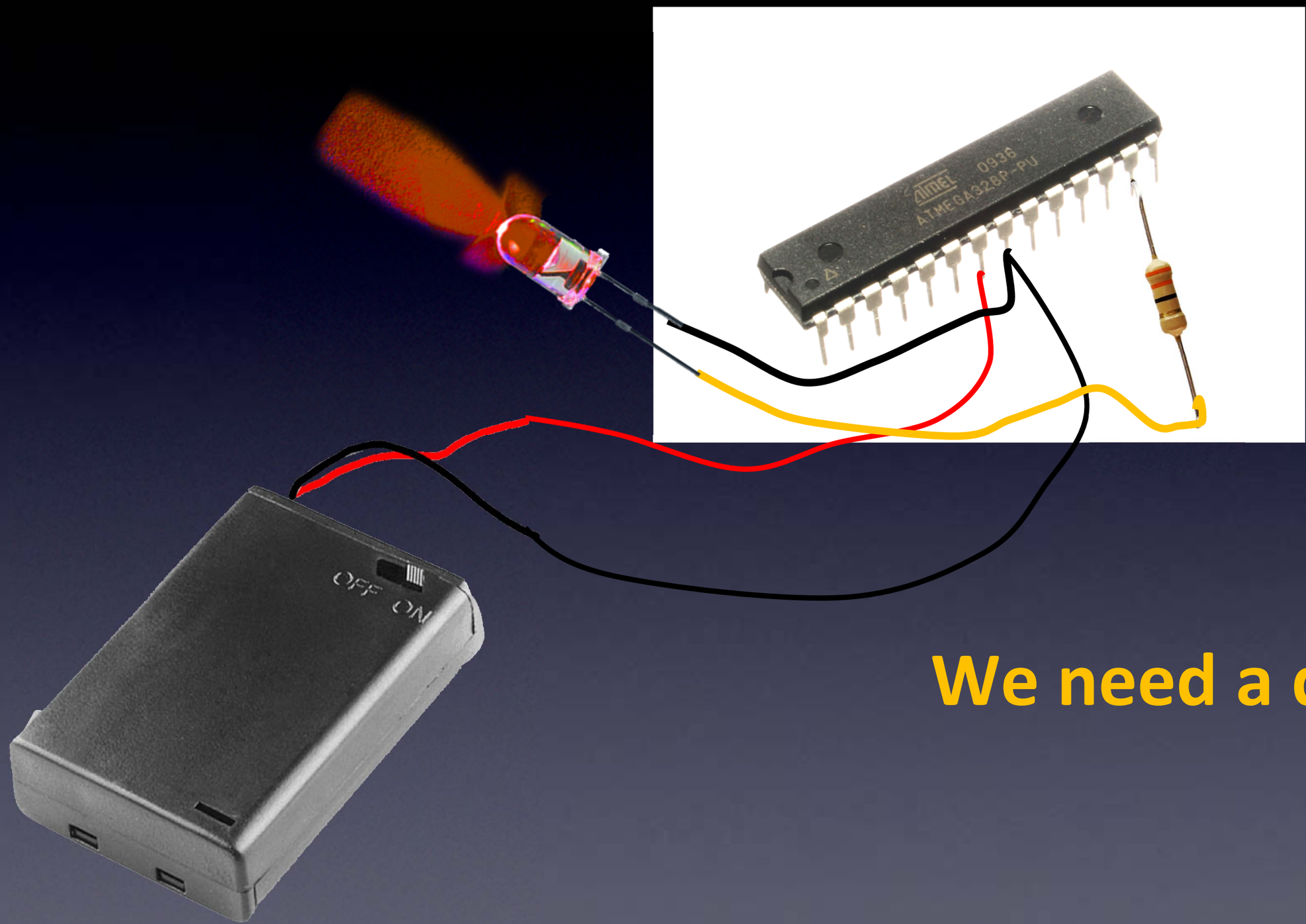
`Hello World !`

Except

We won't see it

Microcontroller

Everything You Need to Know About Electronics

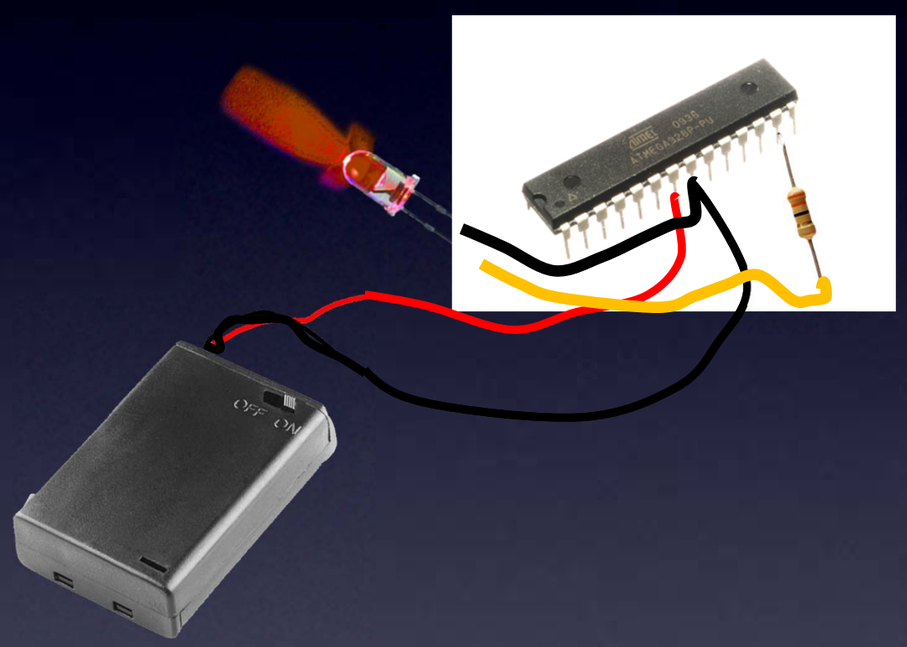


We need a delay

Microcontrollers – they go really fast!

Everything You Need to Know About Electronics

Hardware



Firmware

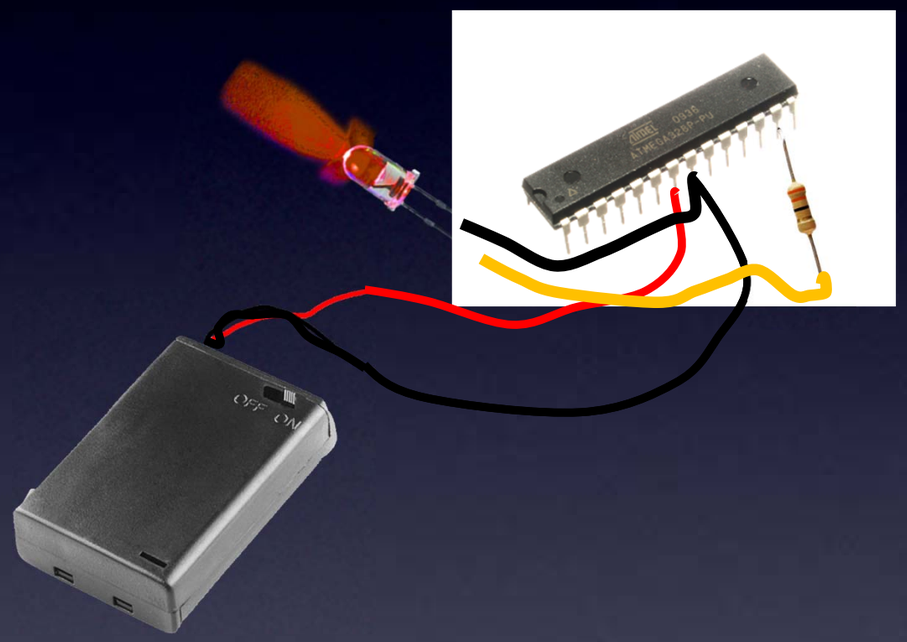
- pin 13 is Output pin
- set pin 13 High
- delay
- set pin 13 Low

`Hello World` – for real now!

Microcontroller – Firmware

What You Need to Know About Electronics

Hardware



Firmware

- pin 13 is Output pin
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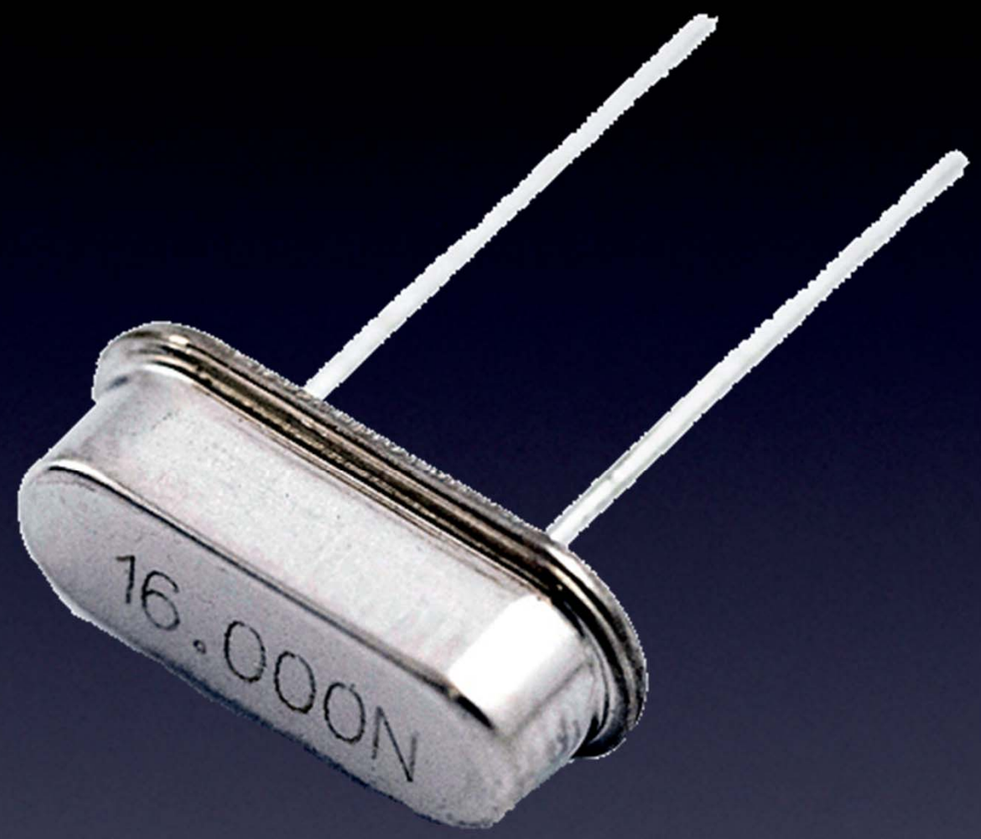
- set pin 13 Low
- delay

`Hello World` – for real now!

Microcontroller – Firmware

Everything You Need to Know About Electronics

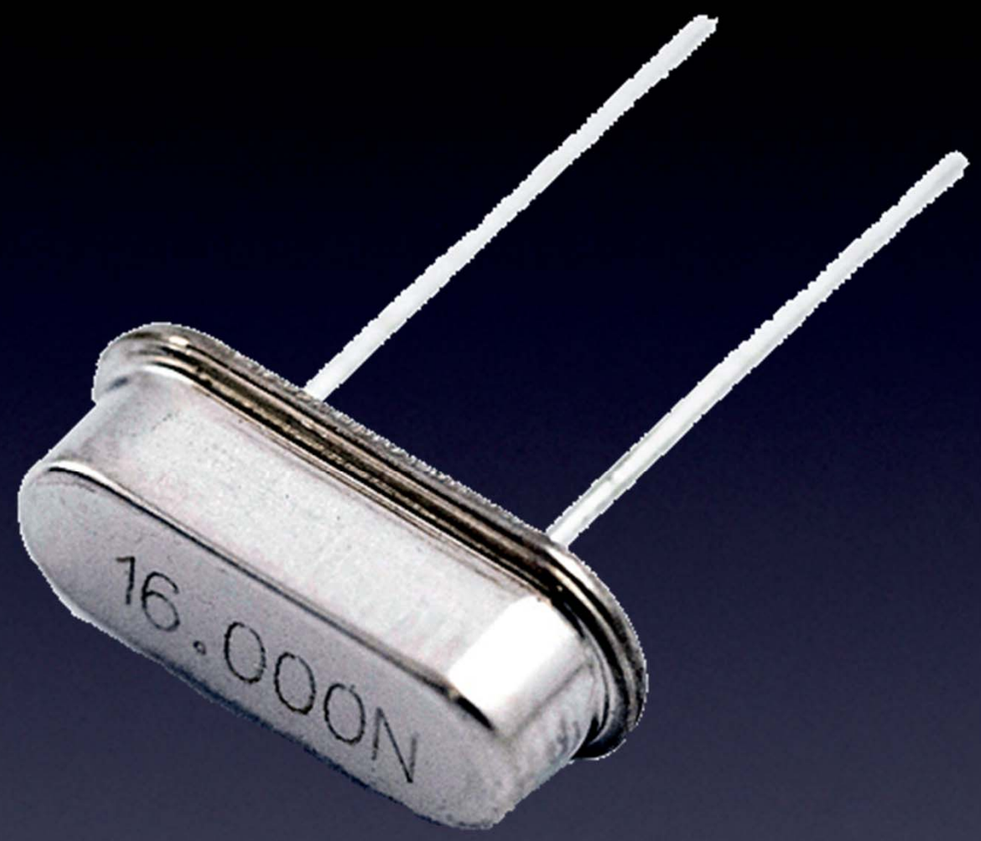


A precision cut piece of quartz crystal

For precise timing

Crystal / Hertz

Everything You Need to Know About Electronics

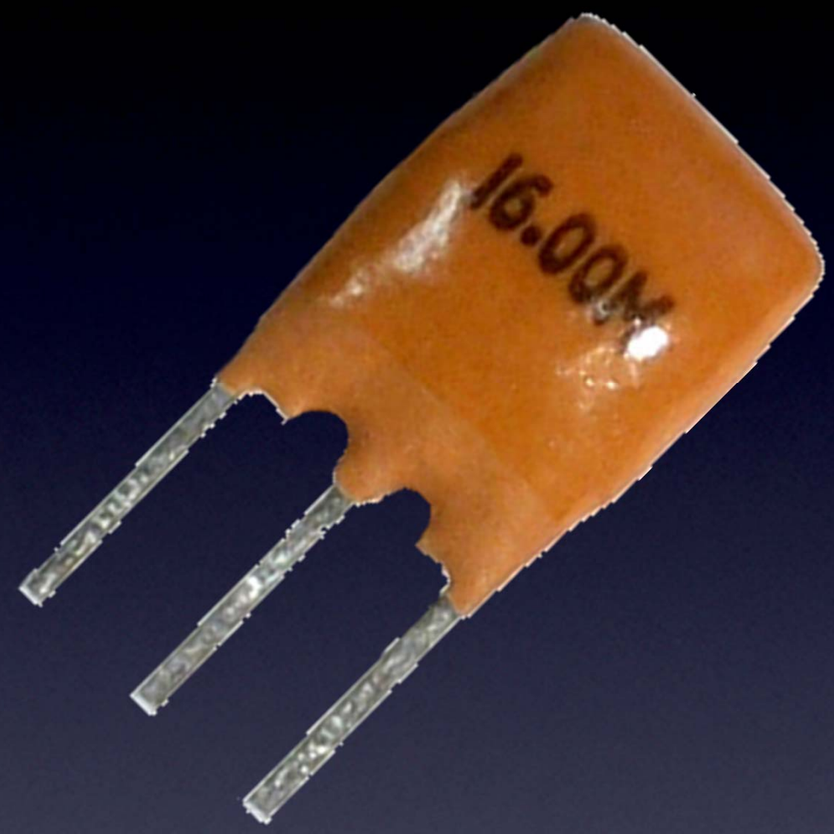


Frequency, measured in Hertz

For precise timing (but less than a crystal)

Crystal / **Hertz**

Everything You Need to Know About Electronics



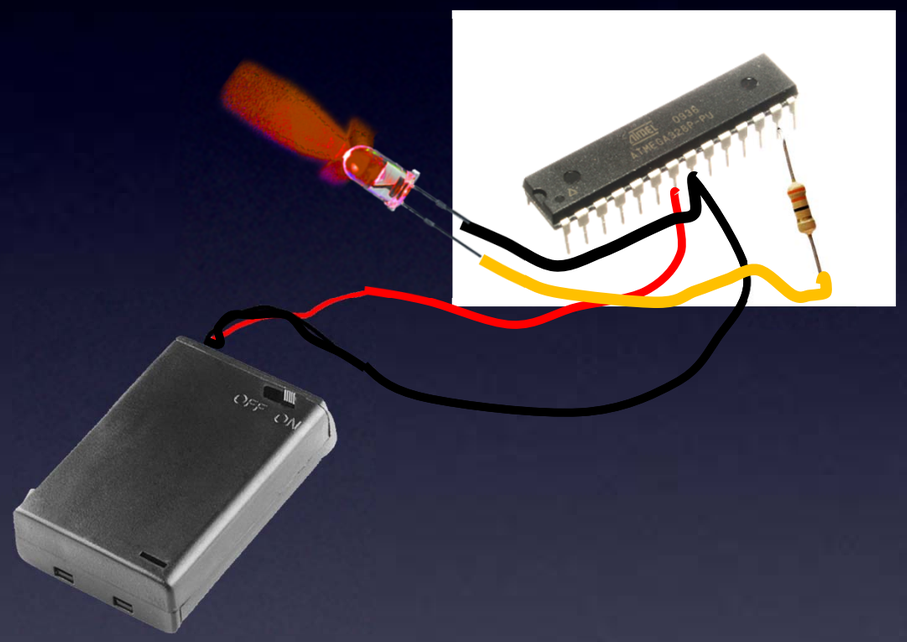
A bunch of resistors and capacitors

For precise timing (but less than a crystal)

Ceramic Resonator / Hertz

Everything You Need to Know About Electronics

Hardware



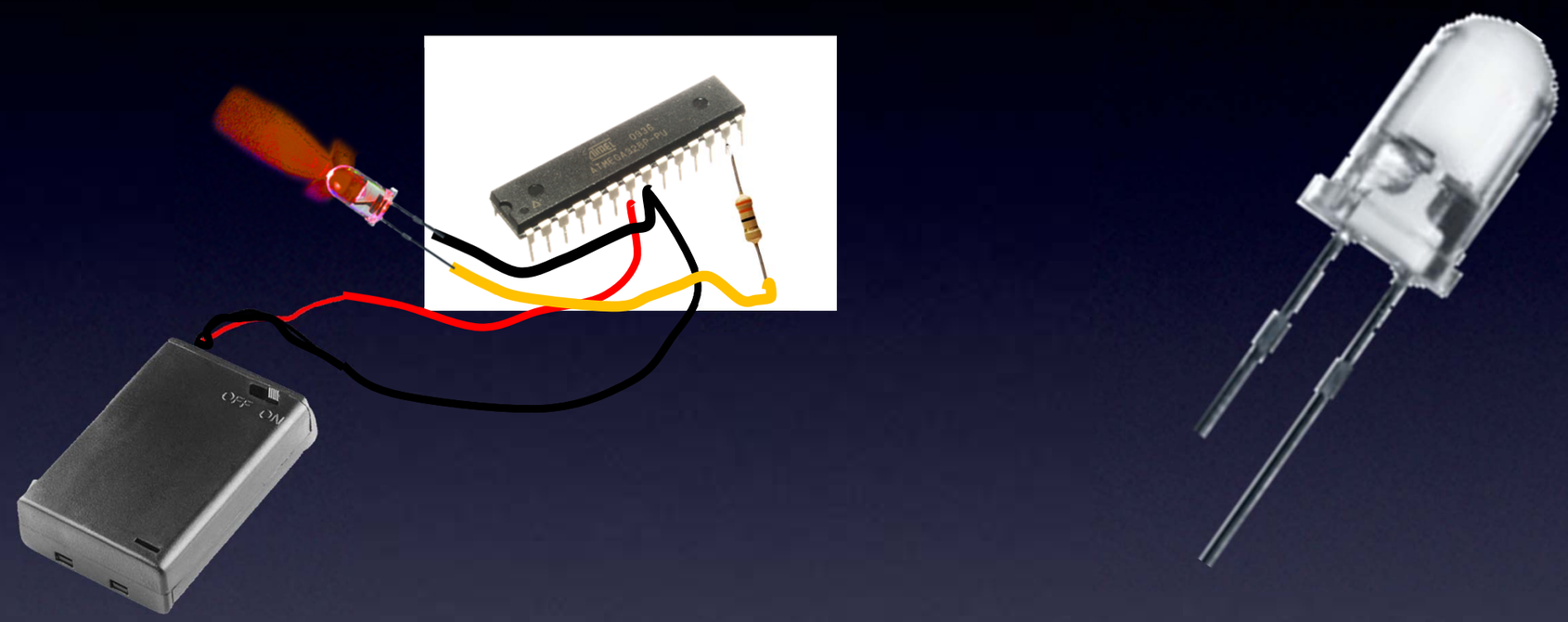
Firmware

- pin 13 is Output pin
- set pin 13 High
- delay
- set pin 13 Low

Let’s hack `Hello World!`

Microcontroller

Everything You Need to Know About Electronics

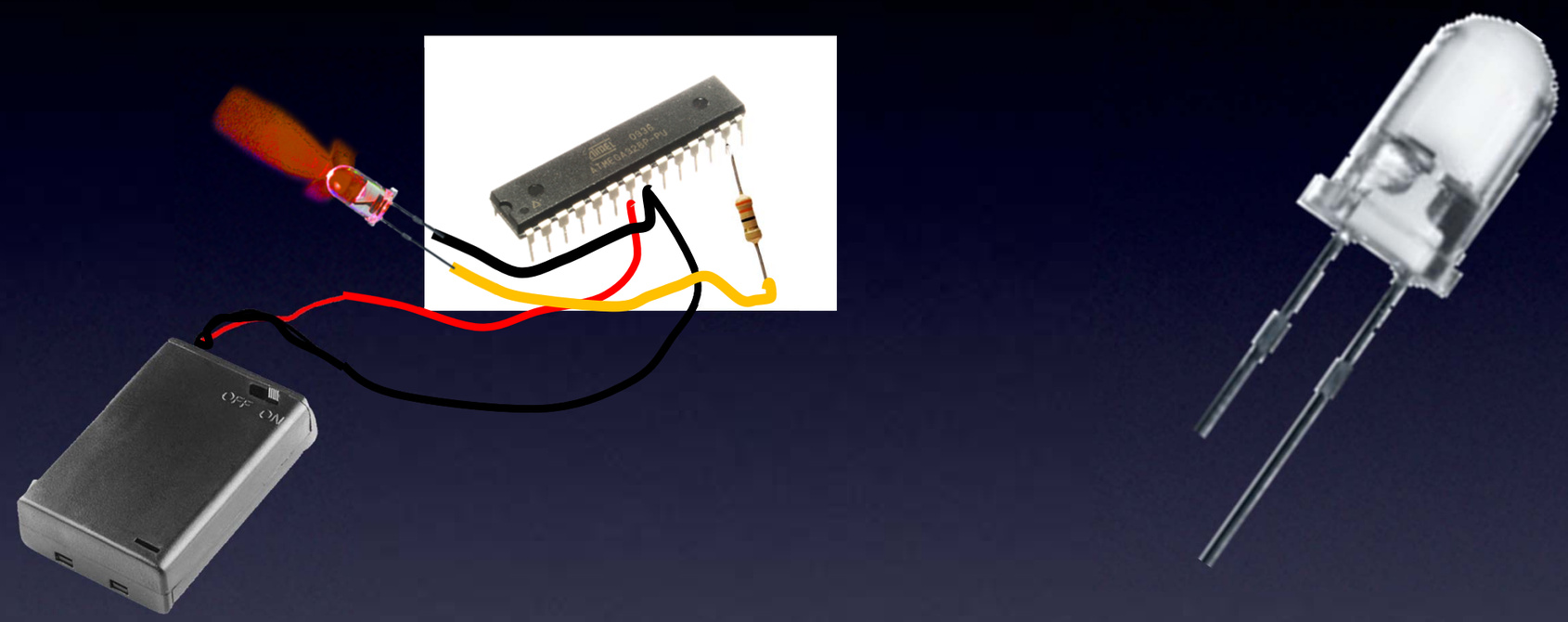


Add an IR LED to another pin

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics

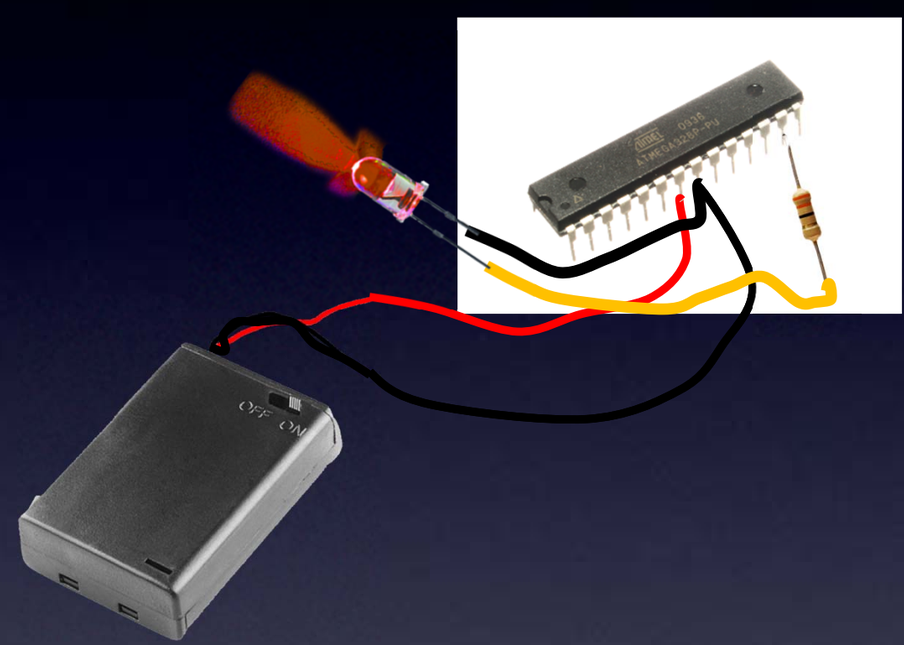


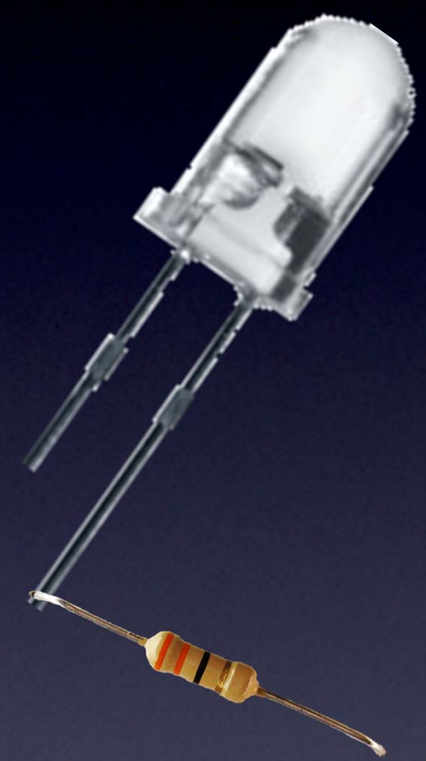
Add an IR LED to another pin (say, pin3)

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics





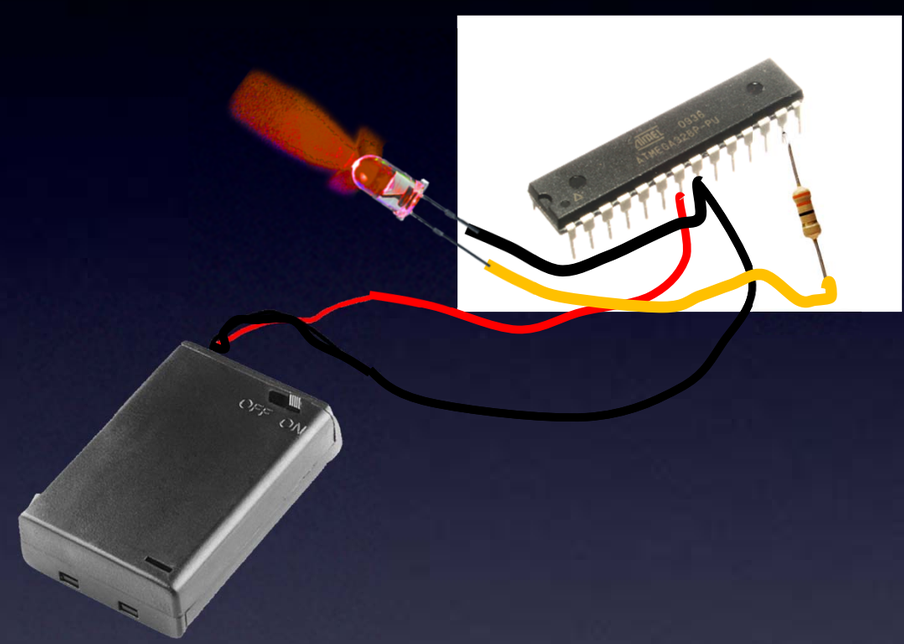
Add an IR LED to another pin (say, pin3)

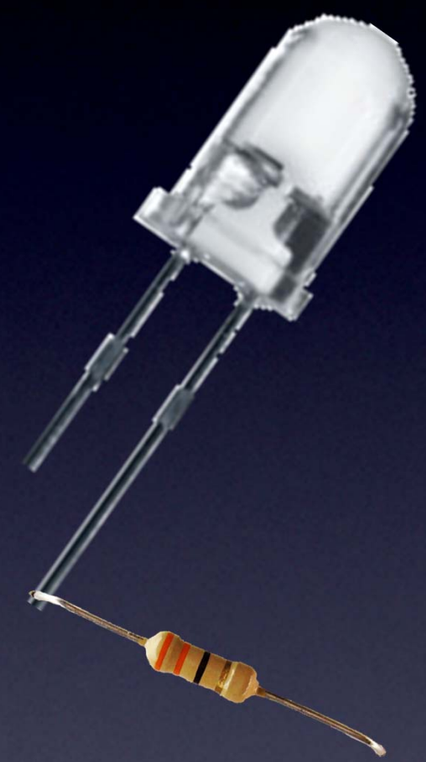
and a resistor so no magic smoke goes away

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



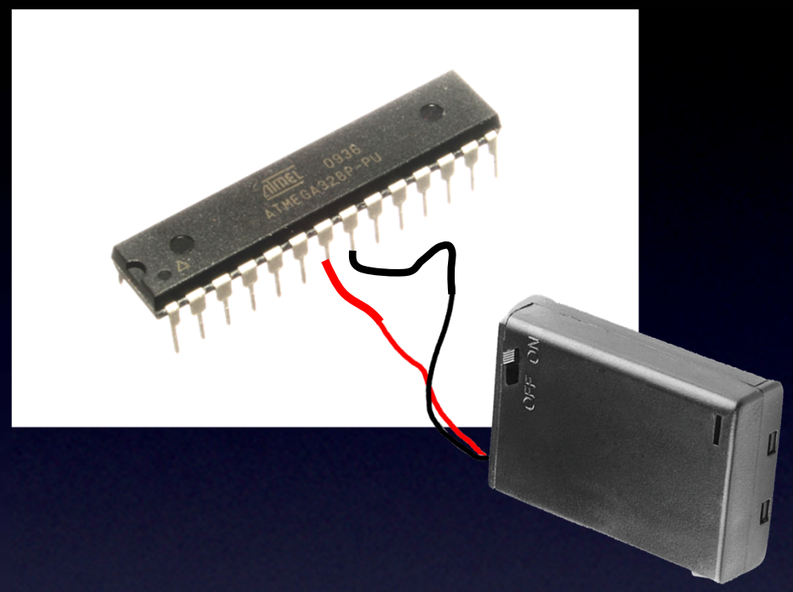


But, *When*?

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



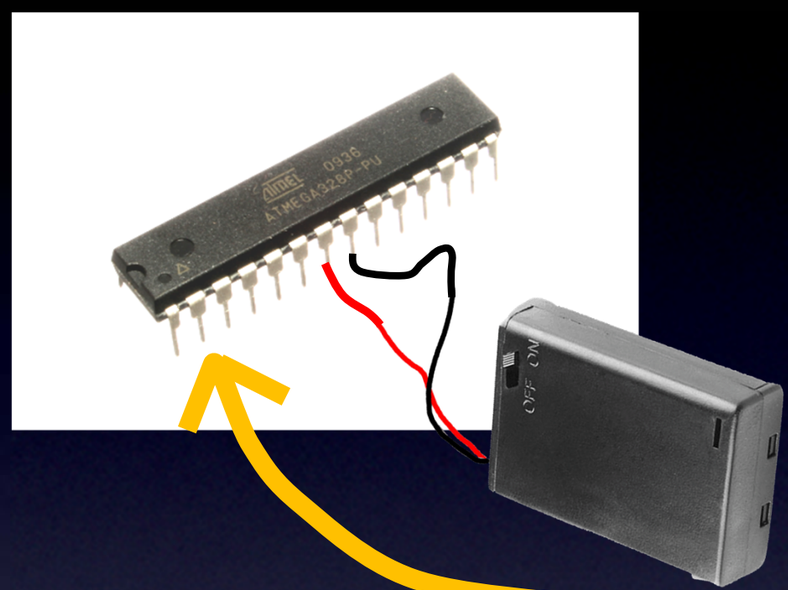
Let’s add an Input pin!

and

We can add a Start button

Microcontroller

Everything You Need to Know About Electronics



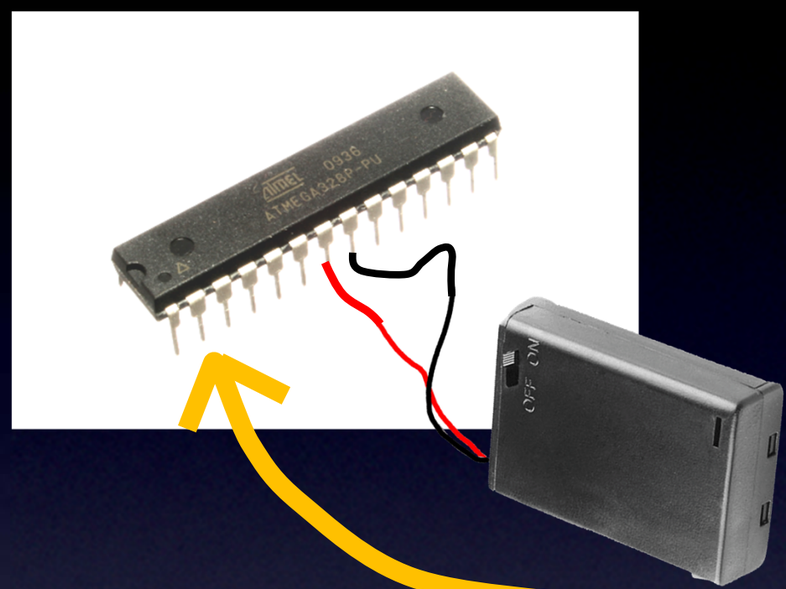
How do we make a pin an Input pin?

We tell it to be one – with our program.

Any pin can be an Input pin (like, pin 2).

Microcontroller – Input pins

Everything You Need to Know About Electronics

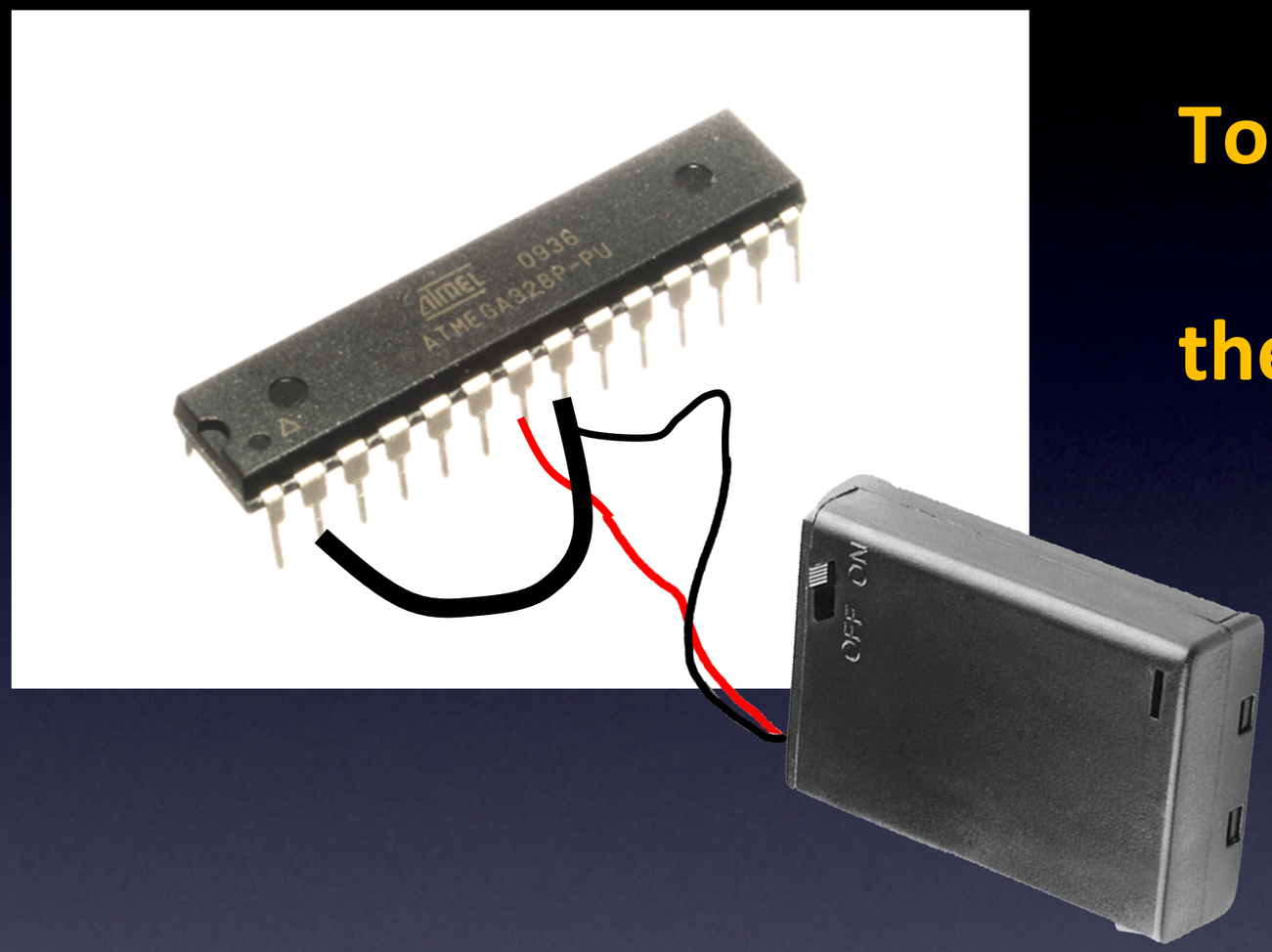


Once we have an **Input pin** (like, pin 2):

only 2 choices – is the Input pin: **High** or **Low** ?

Microcontroller – Input pins

Everything You Need to Know About Electronics

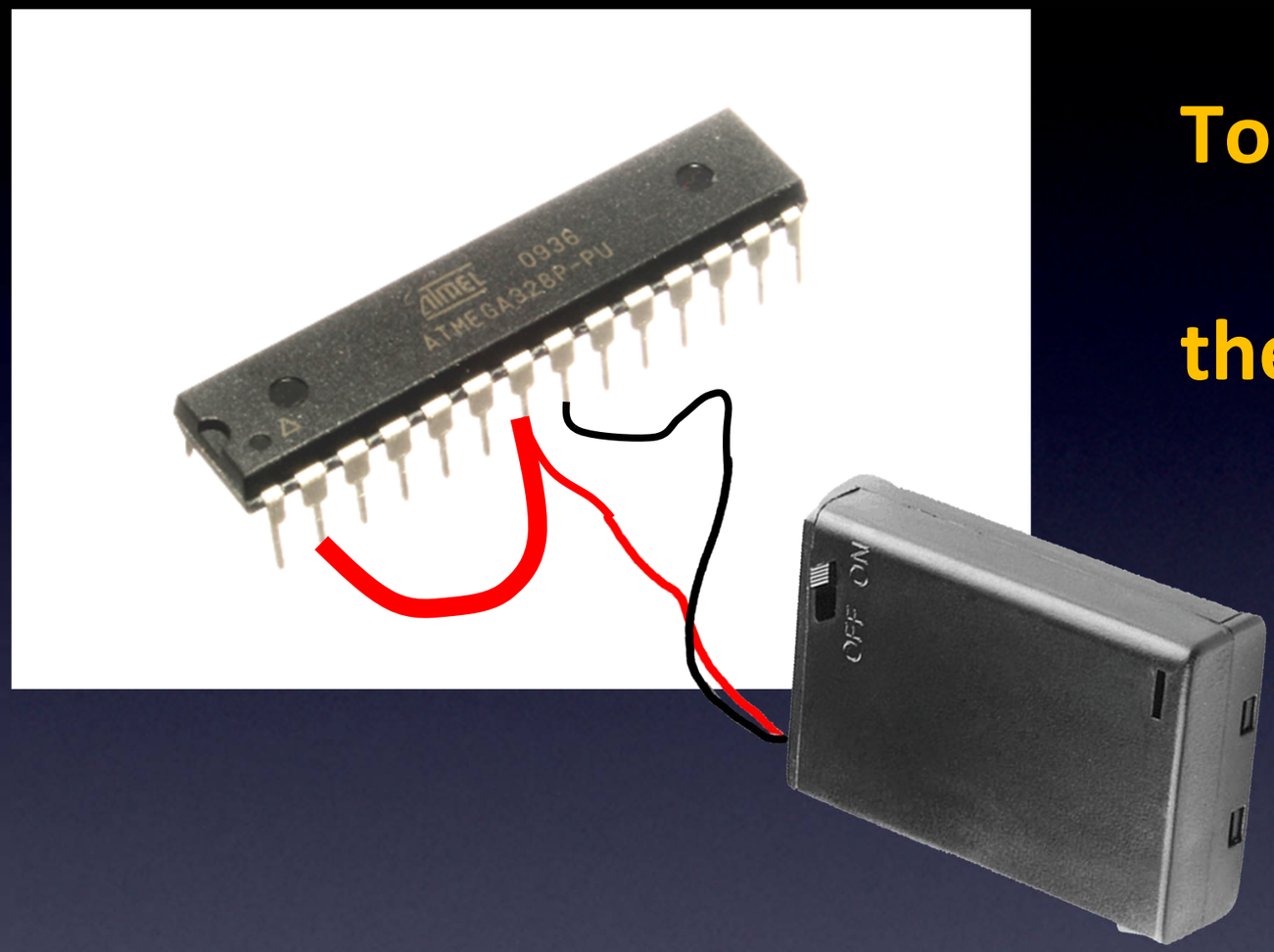


To make the Input pin Low, connect it to the Black wire of our power supply (Ground).

Low

Microcontroller – Input pins

Everything You Need to Know About Electronics

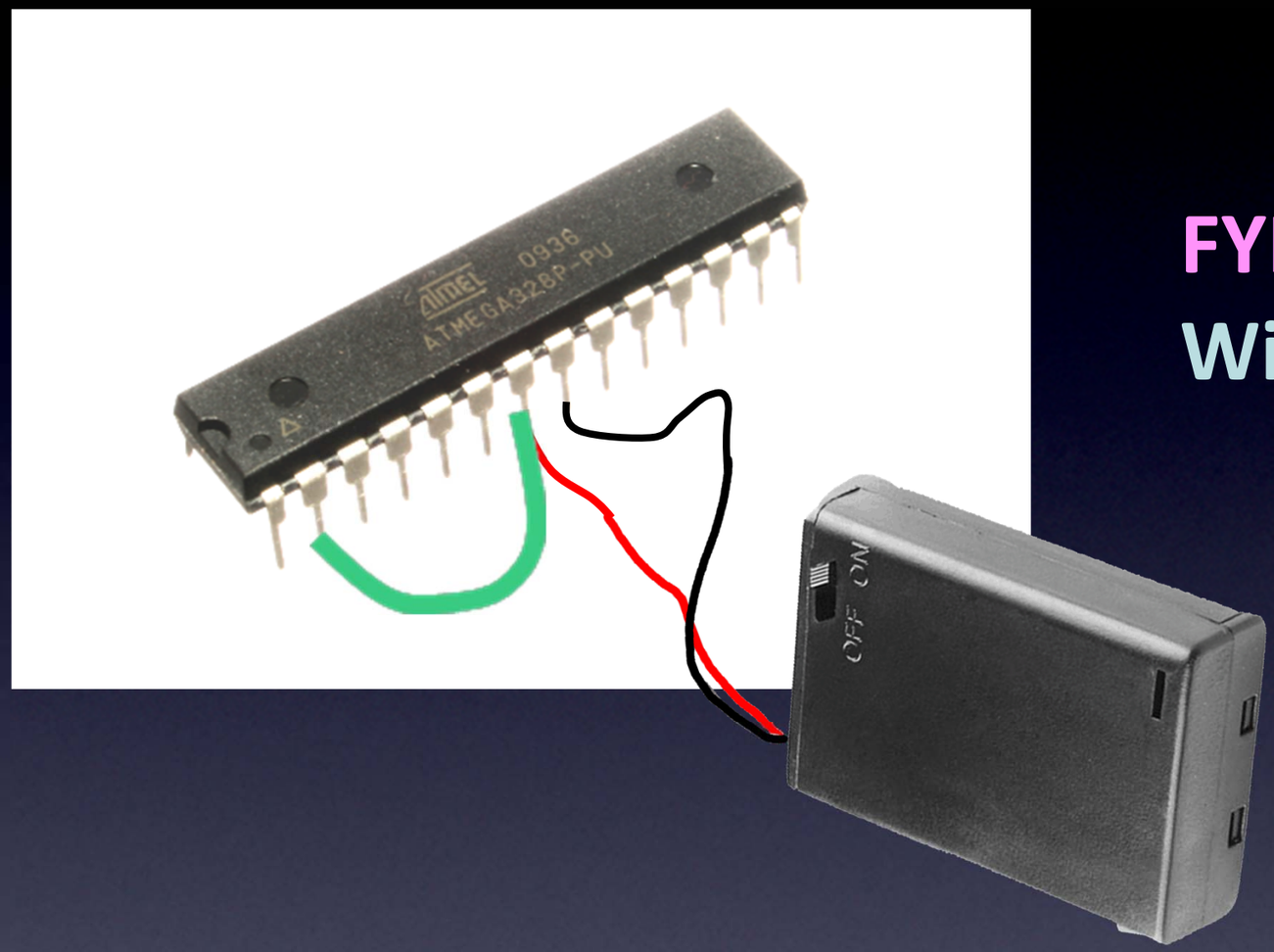


To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

High

Microcontroller – Input pins

Everything You Need to Know About Electronics



FYI:

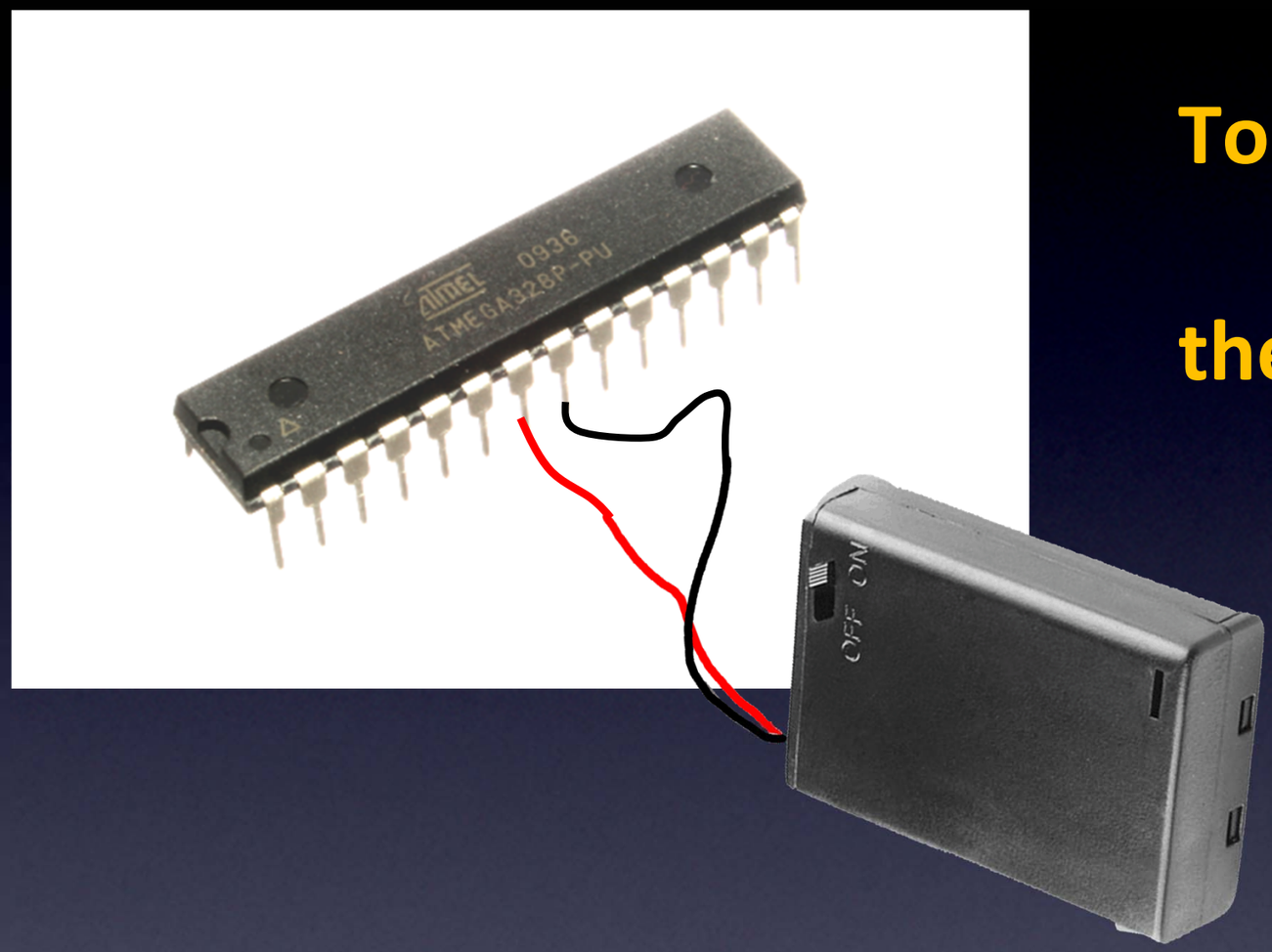
Wire color does not matter !

(electrons don't care)

High

Microcontroller – Input pins

Everything You Need to Know About Electronics



To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

OR:

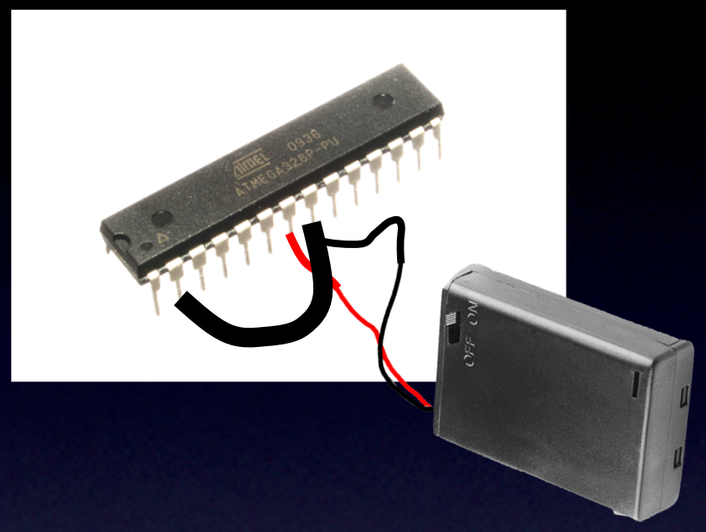
just leave it blank

(built-in resistors on each pin)

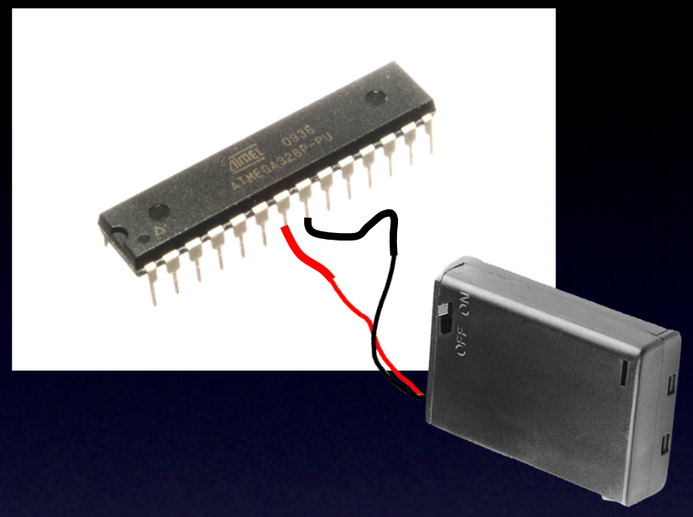
High

Microcontroller – Input pins

Everything You Need to Know About Electronics



If firmware looks at
Pin 2 when it's like this,
it reports back:
Low

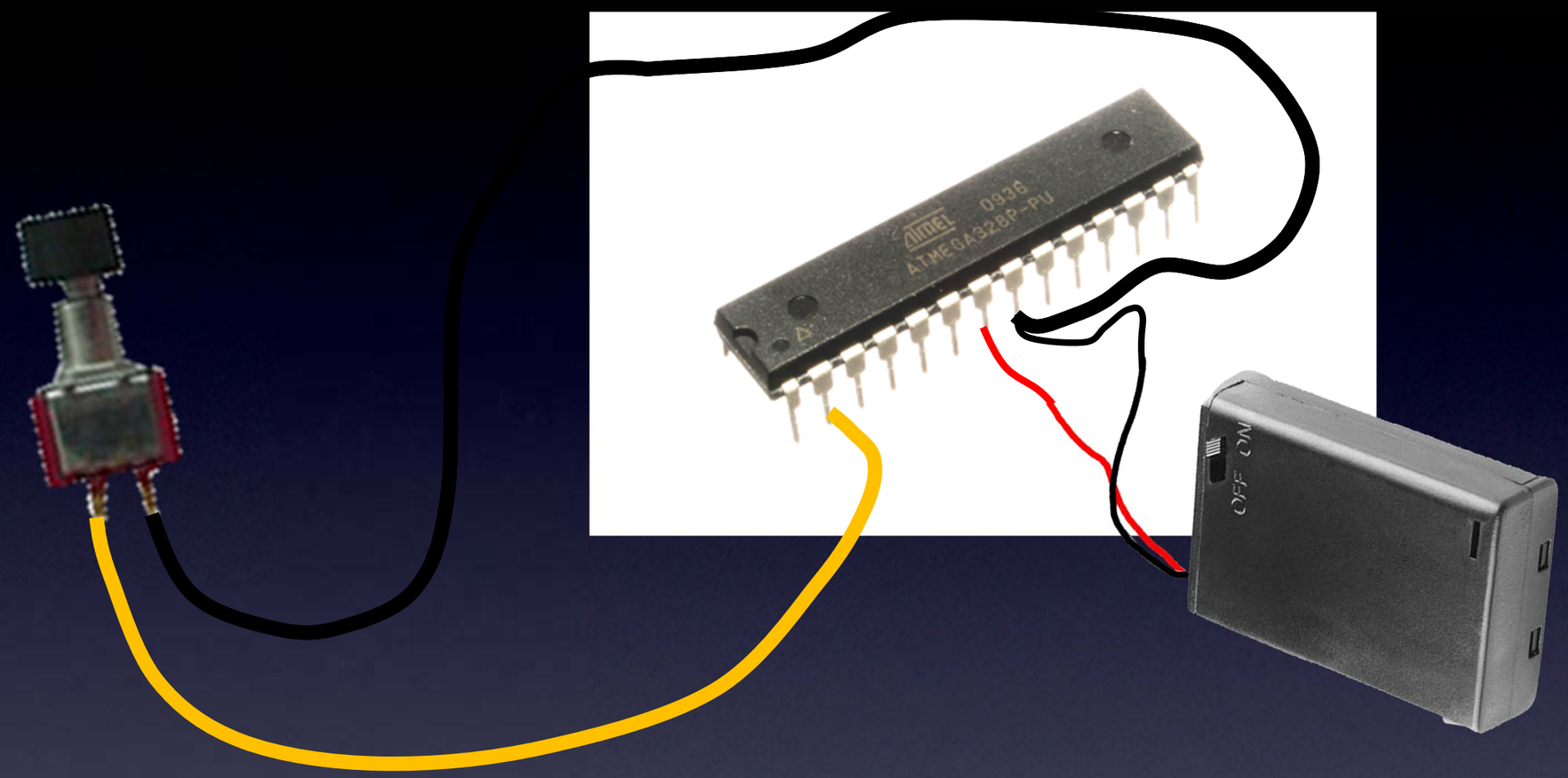


If firmware looks at
Pin 2 when it's like this,
it reports back:
High

Reading the Input pin

Microcontroller – Input pins

Everything You Need to Know About Electronics



Reading the Input pin, with Switch

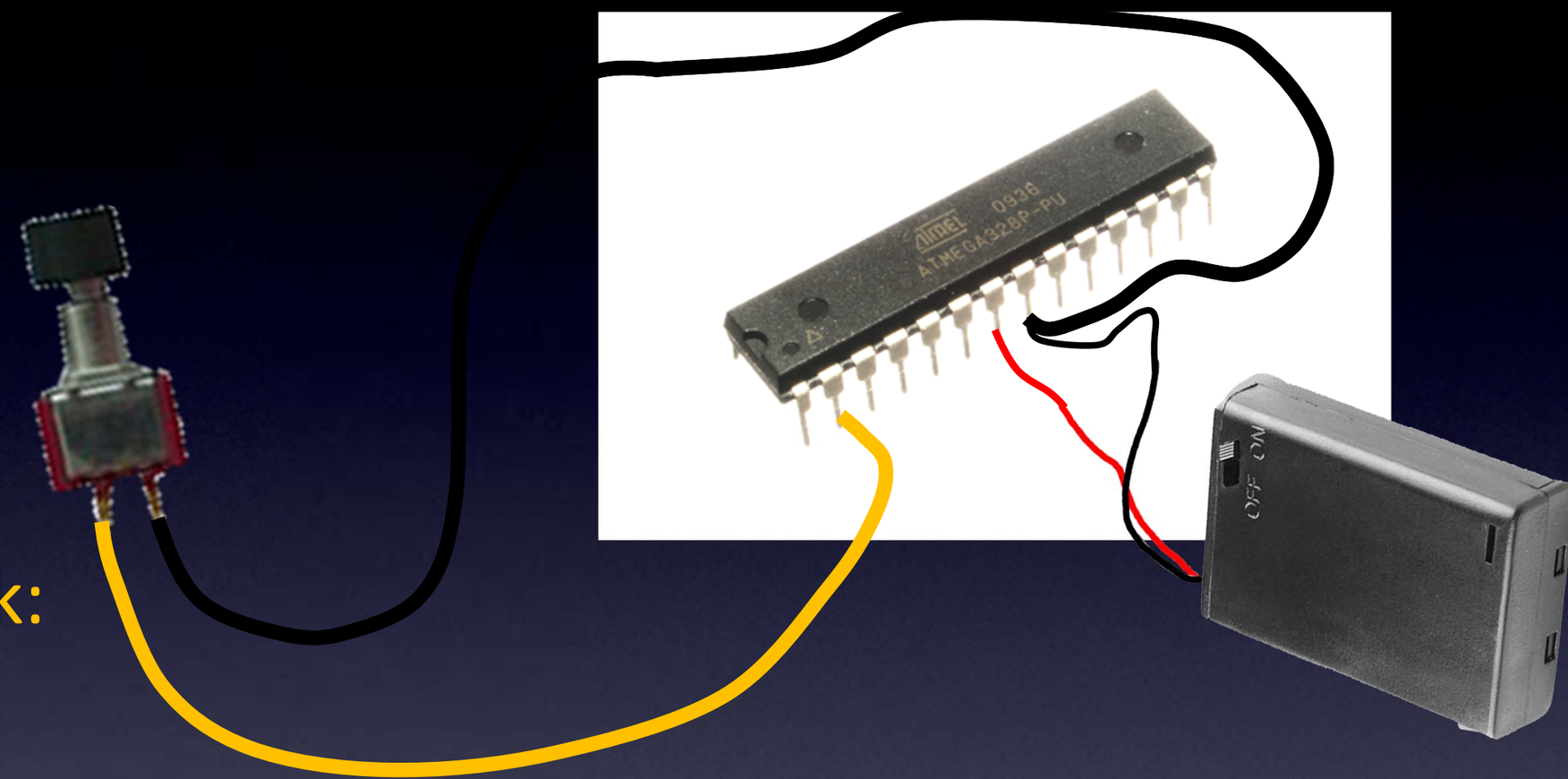
Microcontroller – Input pins

Everything You Need to Know About Electronics

If firmware looks at Pin 2 when switch NOT pushed,

it reports back:

High



Reading the Input pin, with Switch

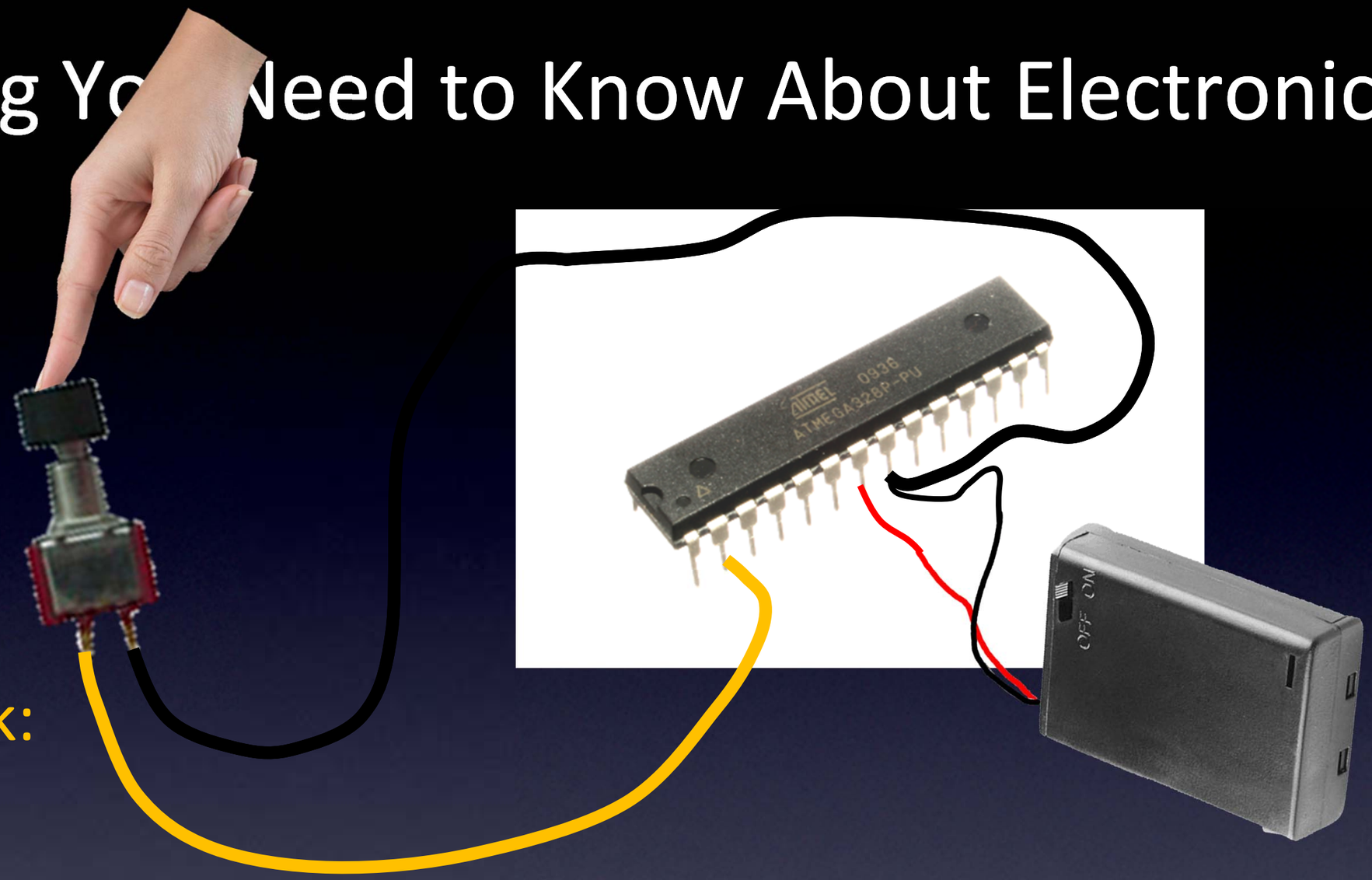
Microcontroller – Input pins

Everything You Need to Know About Electronics

If firmware looks at Pin 2 when switch pushed,

it reports back:

Low



Reading the Input pin, with Switch

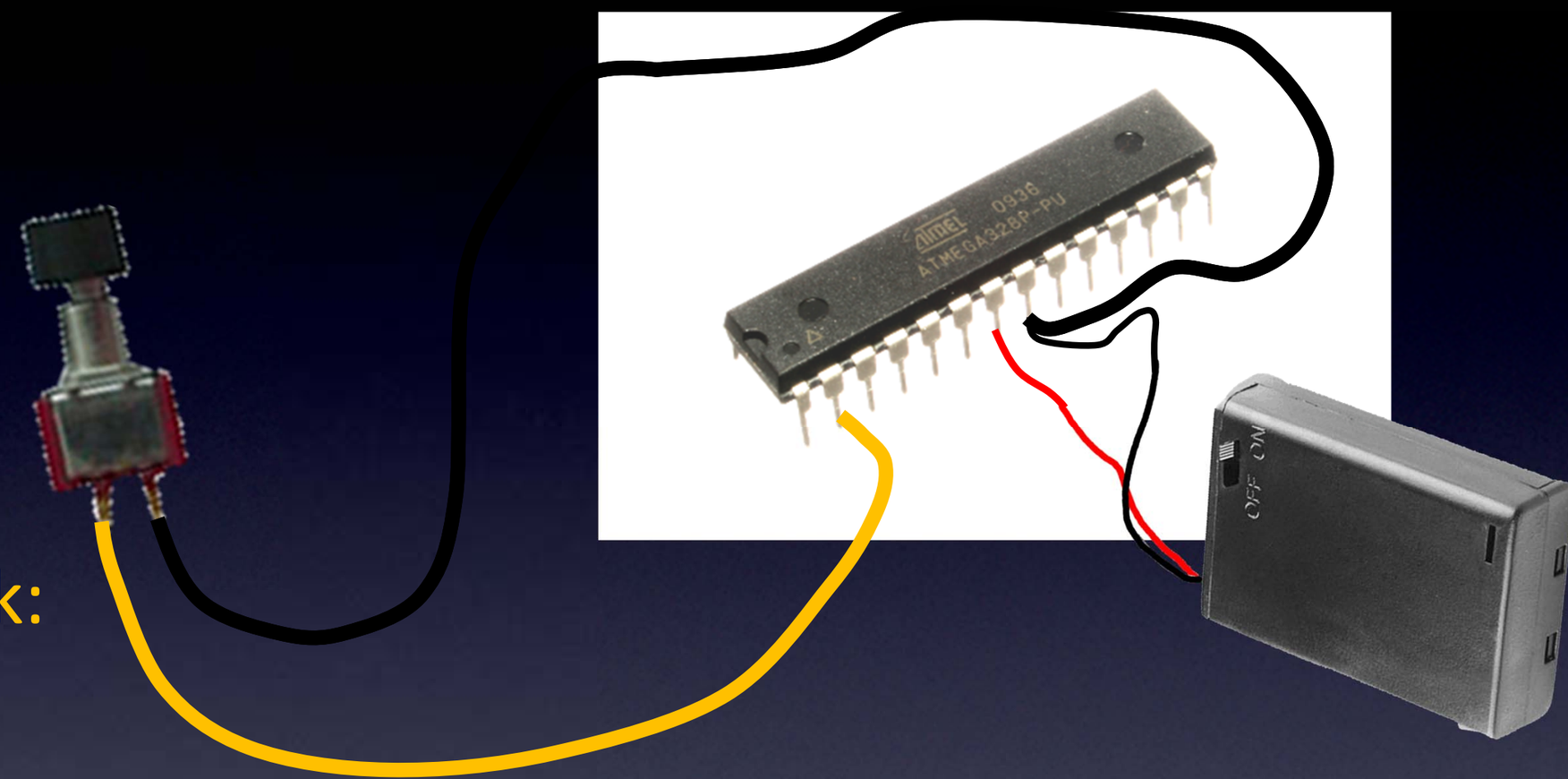
Microcontroller – Input pins

Everything You Need to Know About Electronics

If firmware looks at Pin 2 when switch NOT pushed,

it reports back:

High

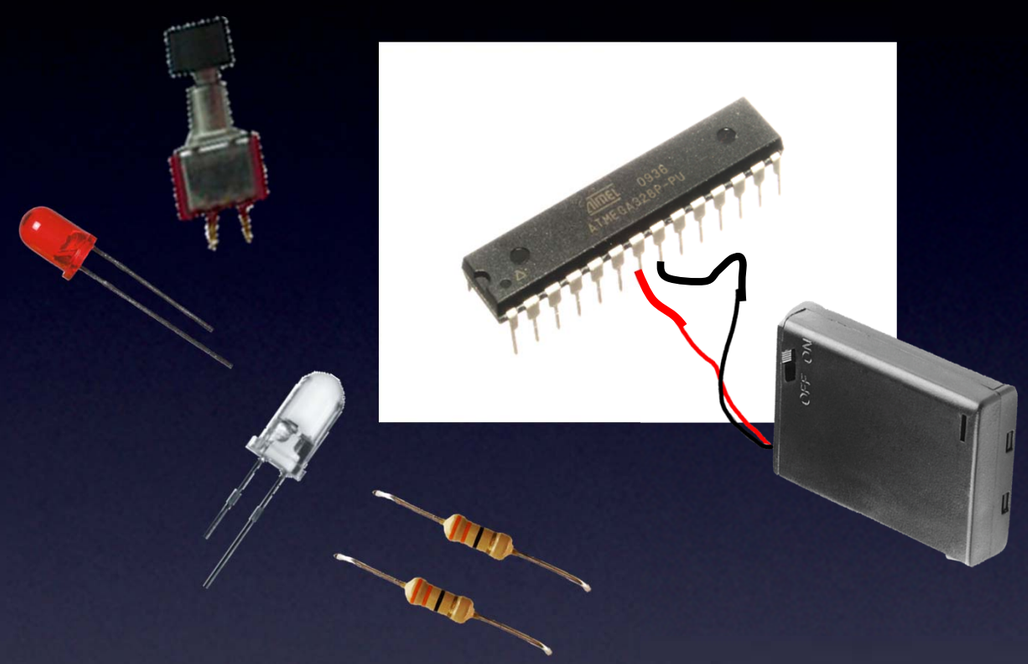


Reading the Input pin, with Switch

Microcontroller – Input pins

Everything You Need to Know About Electronics

Hardware



Firmware

Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

Wait for Switch to be Low

Blink visible LED:
High, Delay, Low
Pulse IR LED for Sony "OFF" code:
High, Delay, Low, Delay…

Blink visible LED:
High, Delay, Low
Pulse IR LED for Panasonic "OFF" code:
High, Delay, Low, Delay…

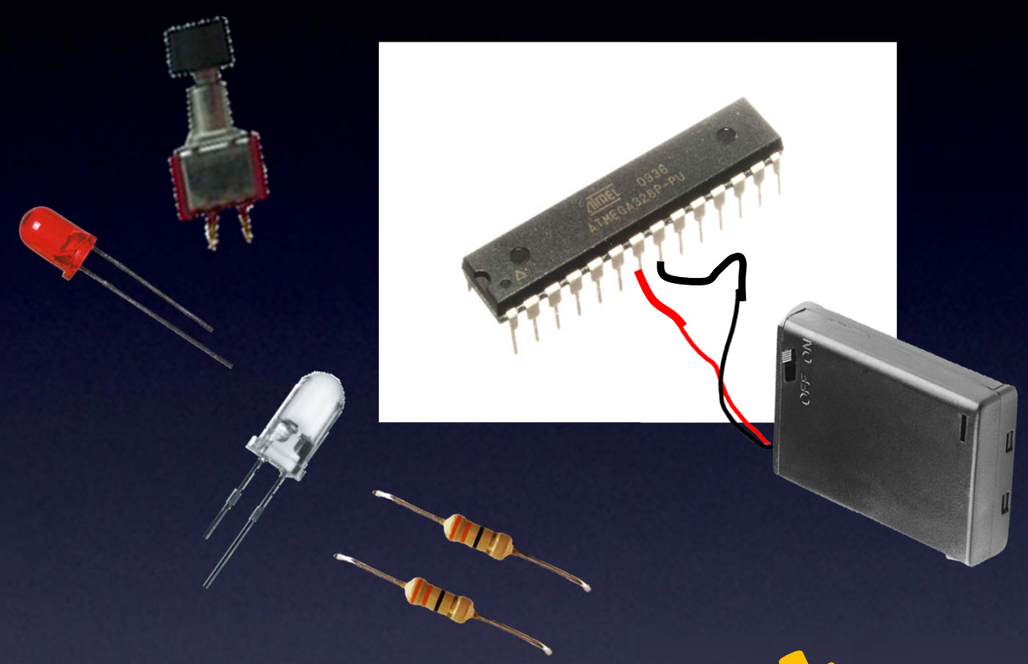
Etc for all "OFF" codes

TV-B-Gone remote control

Microcontroller

Everything You Need to Know About Electronics

Hardware



Except

doesn't go very far

Firmware

Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

Wait for Switch to be Low

Blink visible LED:
High, Delay, Low
Pulse IR LED for Sony "OFF" code:
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High, Delay, Low, Delay…

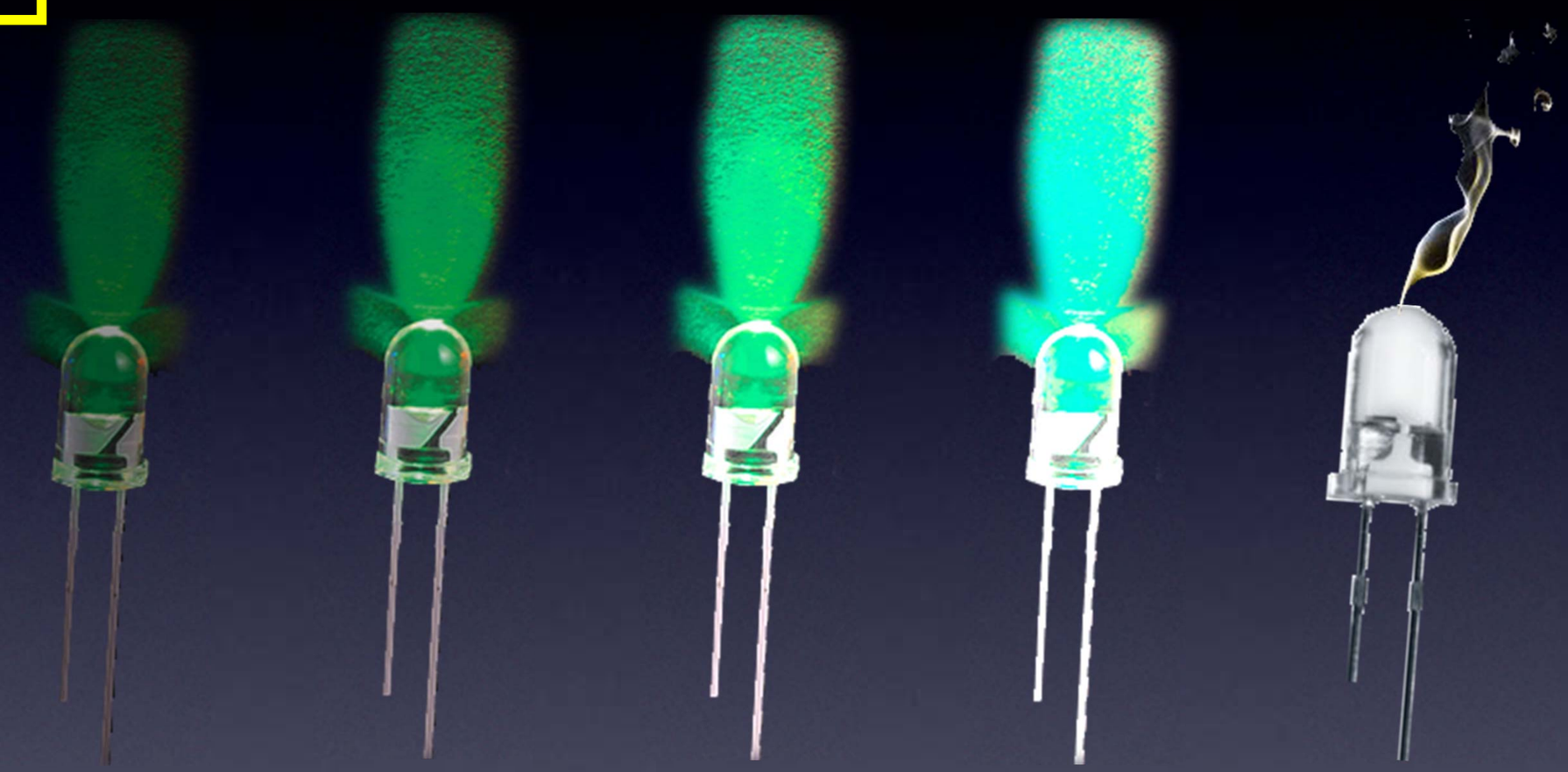
Etc for all "OFF" codes

TV-B-Gone remote control

Microcontroller

Everything You Need to Know About Electronics

Review:



More current → More brightness! (until…)

LED

Everything You Need to Know About Electronics

Output pin – only 2 choices:

Low

Off

(0V)

High

On

(Power supply voltage

-- controlled by our Firmware!)

Output pins

only allow

limited current

(built-in resistors on each pin)

Microcontroller – Output pins

Everything You Need to Know About Electronics

dimmly lit LED

So,
IR LED
can only light up
dimly
from the Output pin

Output pin – only 2 choices:

Low	**High**
Off	**On**
(0V)	(Power supply voltage
	-- controlled by our Firmware!)

Output pin – only limited current

Microcontroller – Output pins

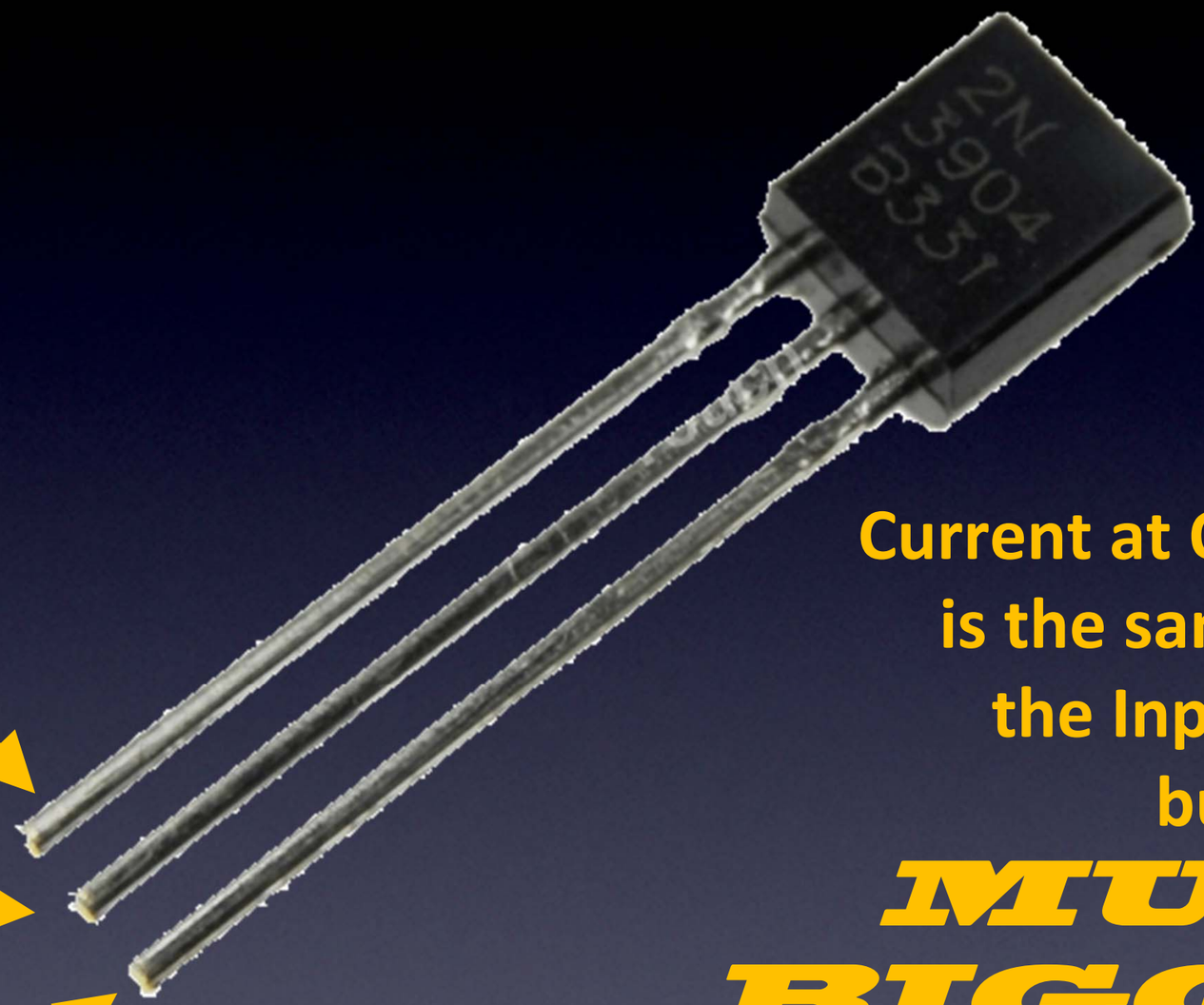
Everything You Need to Know About Electronics

So,
let's amplify
the current
from the Output pin

with
a

Current amplifier !

Everything You Need to Know About Electronics



Ground

Input

Output

Current at Output lead is the same as for the Input lead but

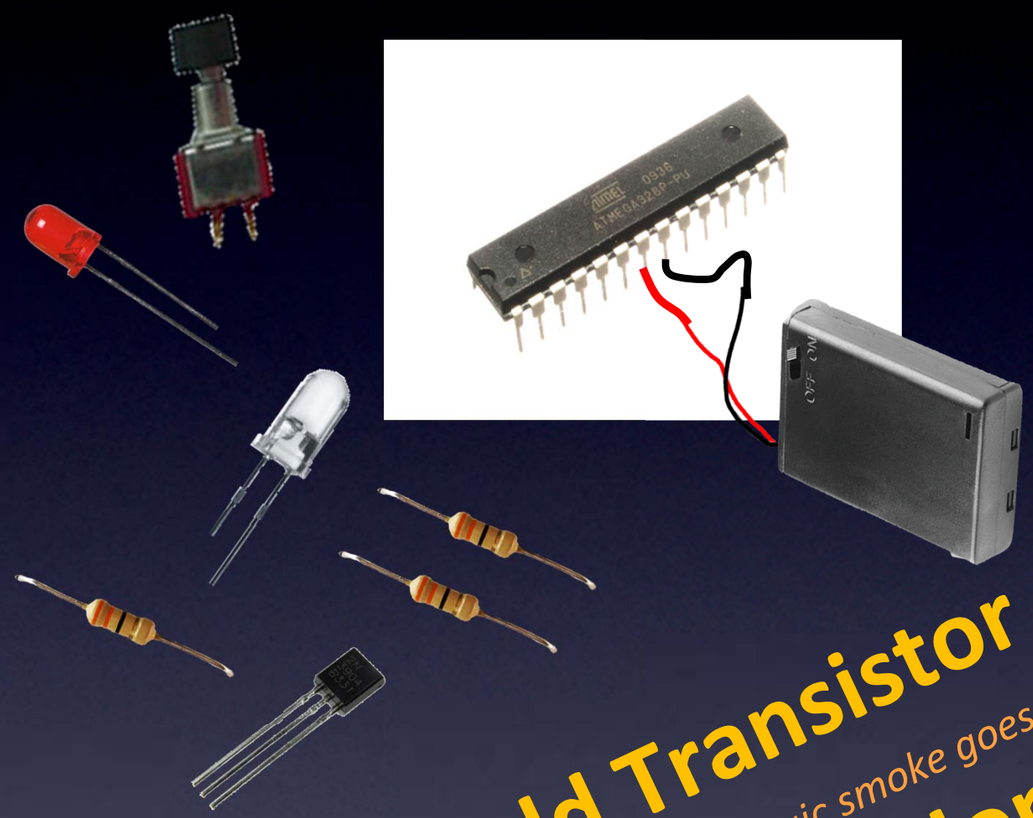
MUCH BIGGER !

Current amplifier

Transistor

Everything You Need to Know About Electronics

Hardware



Add Transistor
(and a resistor so no magic smoke goes away)
and, we're done!

Firmware

Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

Wait for Switch to be Low

Blink visible LED:
High, Delay, Low
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Blink visible LED:
High, Delay, Low
Pulse IR LED for Panasonic "OFF" code:
High, Delay, Low, Delay…

Etc for all "OFF" codes

TV-B-Gone remote control – we're done!

Microcontroller

And, that is

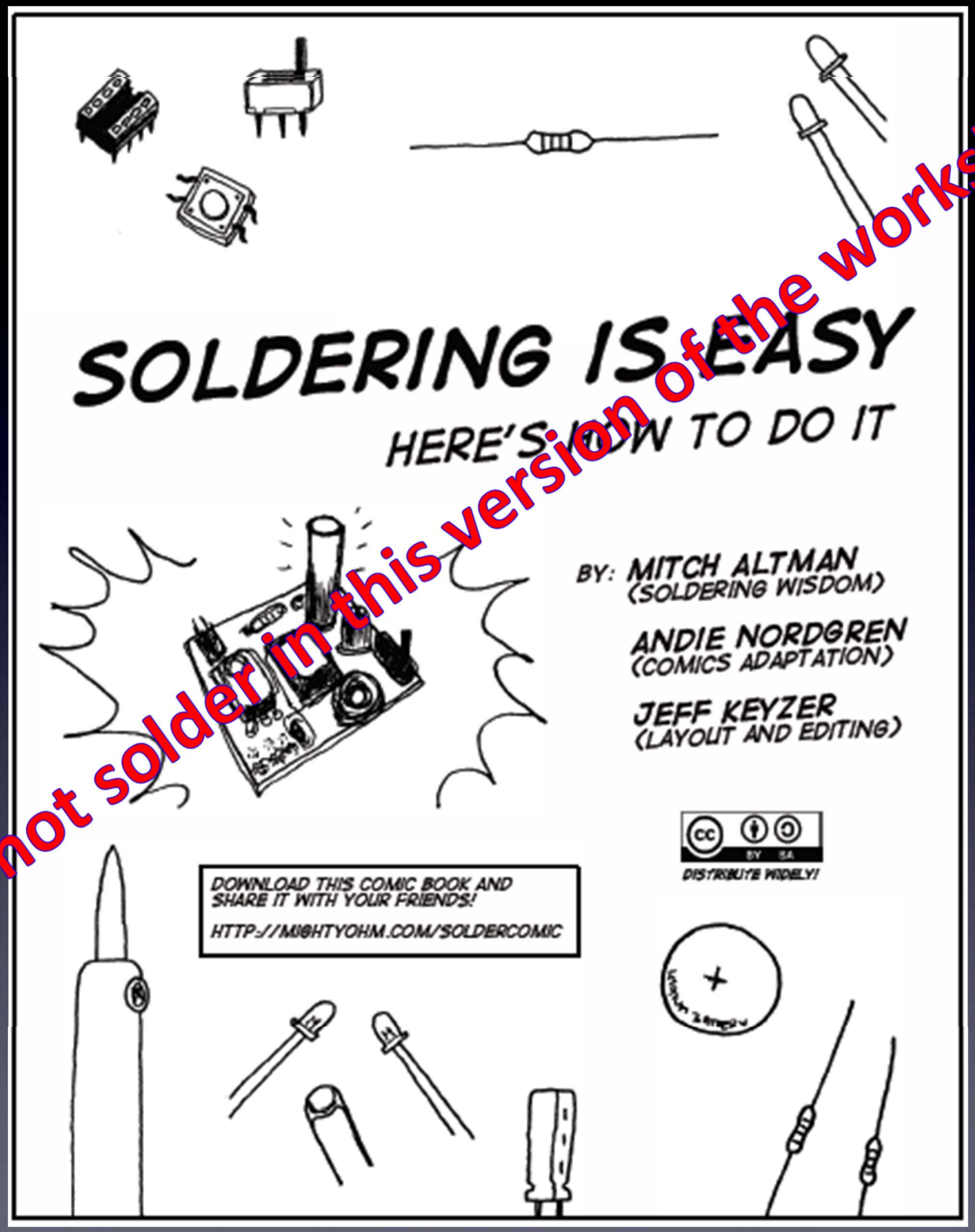
And, that is

Everything You Need to Know About

Electronics

Questions?

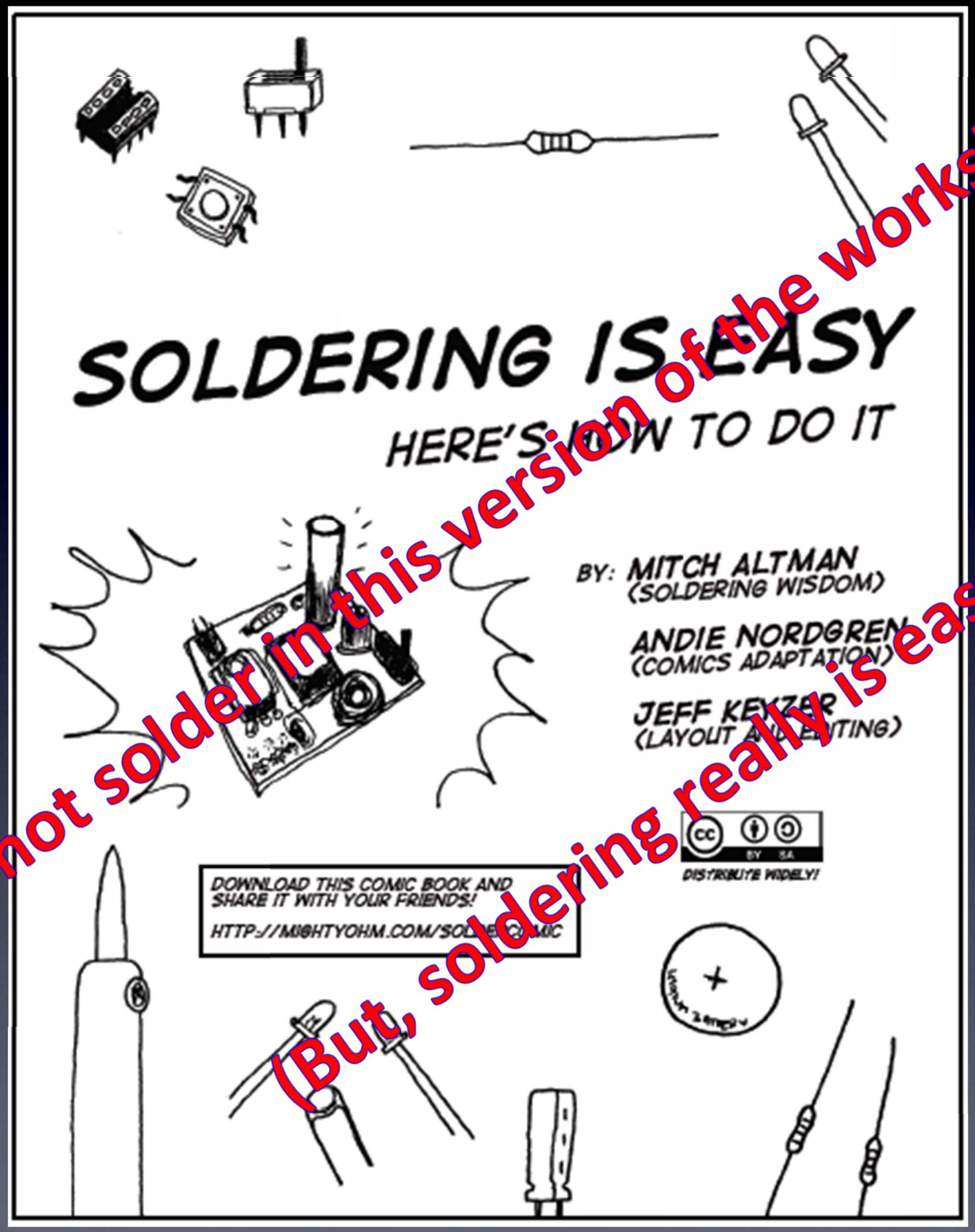
Learn To Solder



We will not solder in this version of the workshop

download for free at:
http://mightyohm.com/soldercomic

Learn To Solder

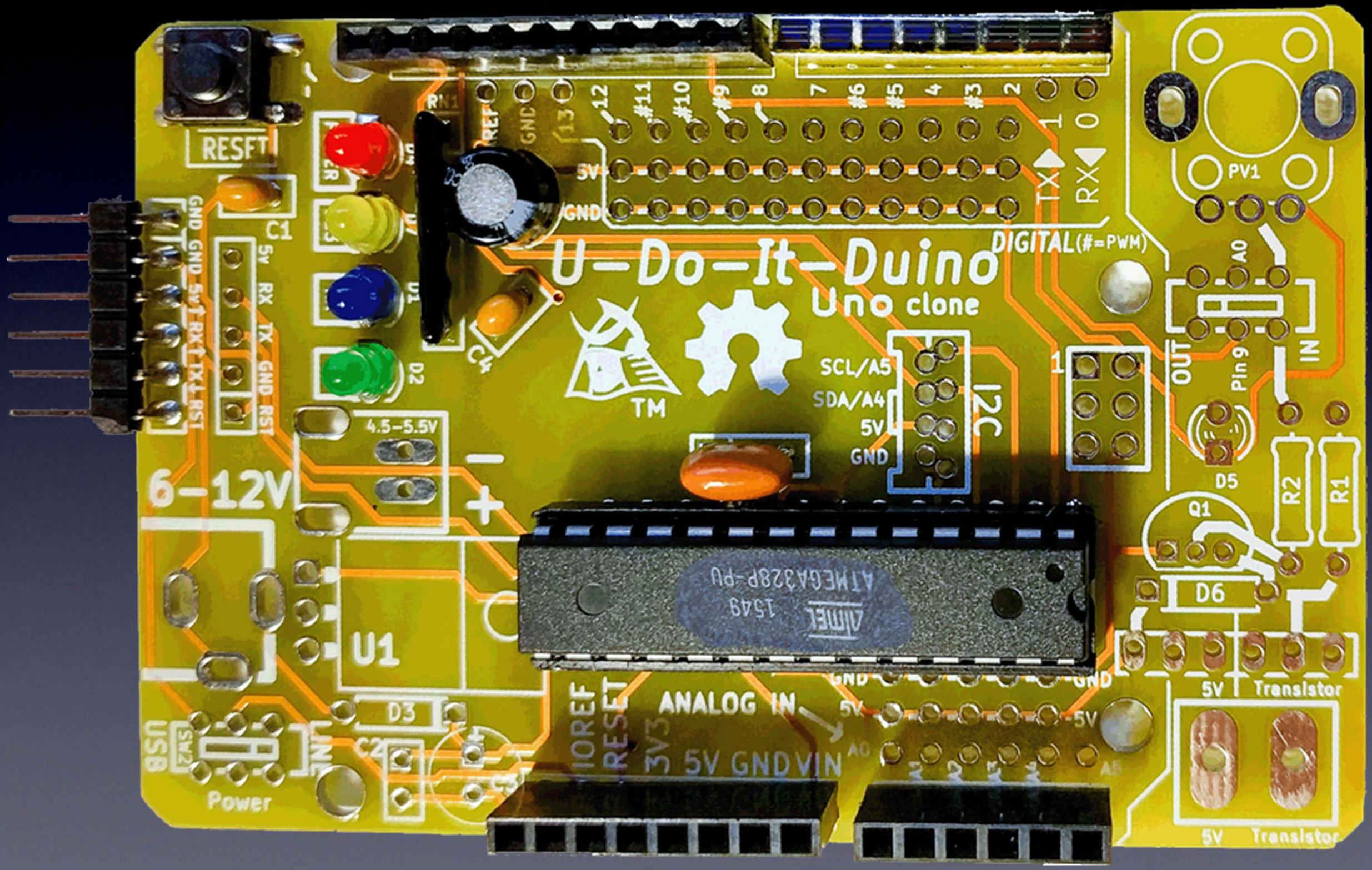


We will not solder in this version of the workshop

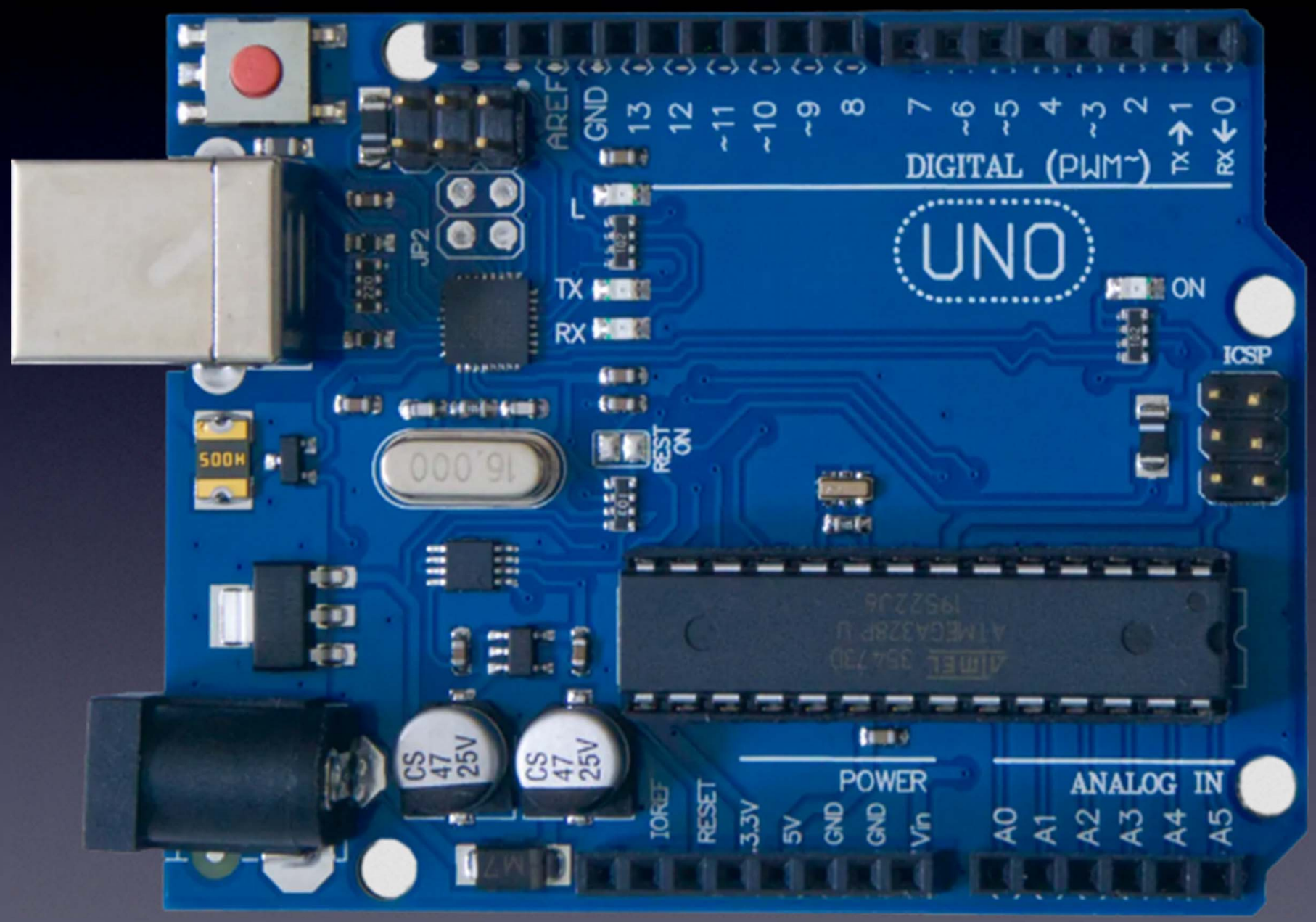
(But, soldering really is easy!)

download for free at:
http://mightyohm.com/soldercomic

We will not solder in this version of the workshop

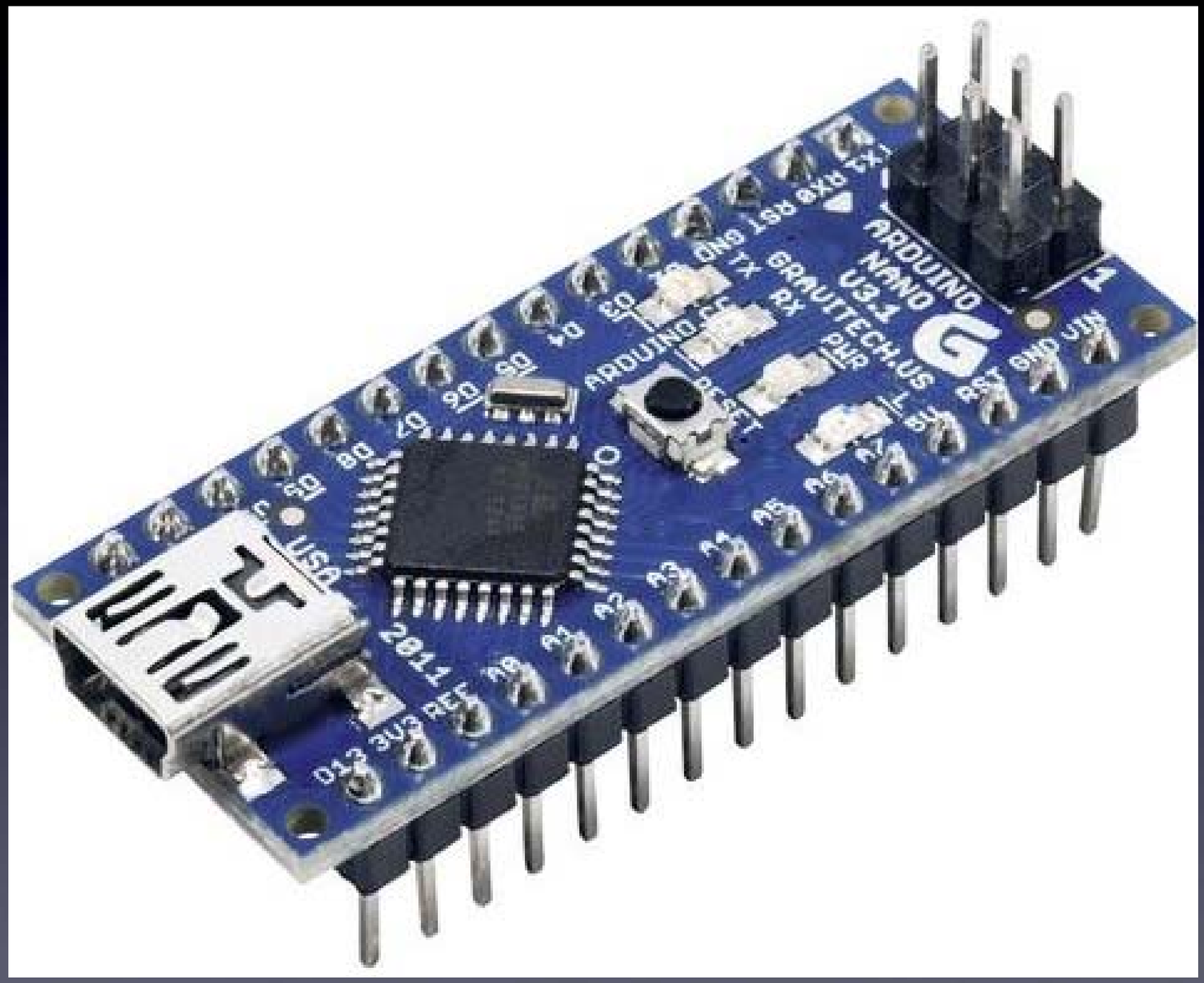


We will use a ready-made Arduino “Clone”



Uno clone

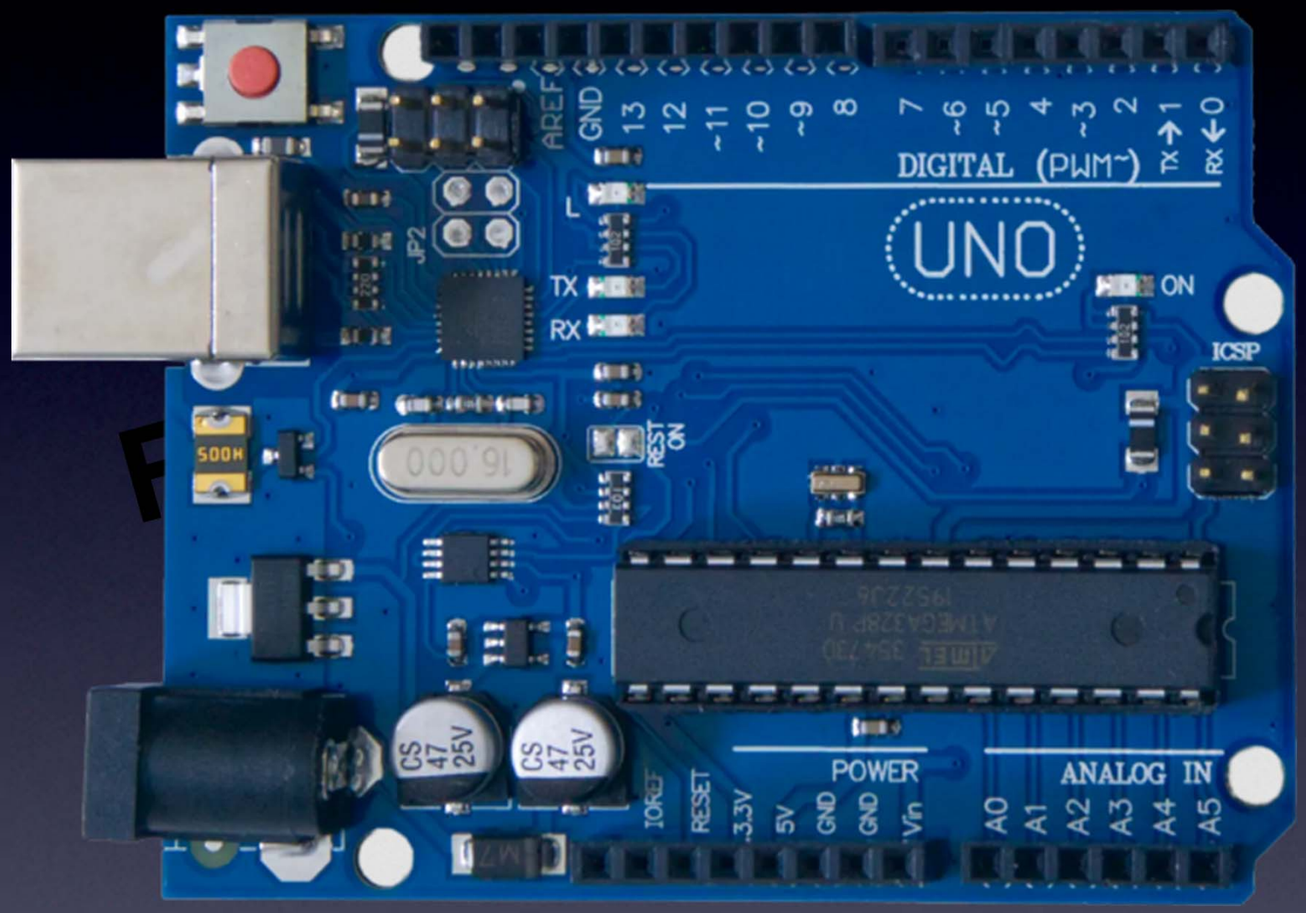
We will use a ready-made Arduino “Clone”

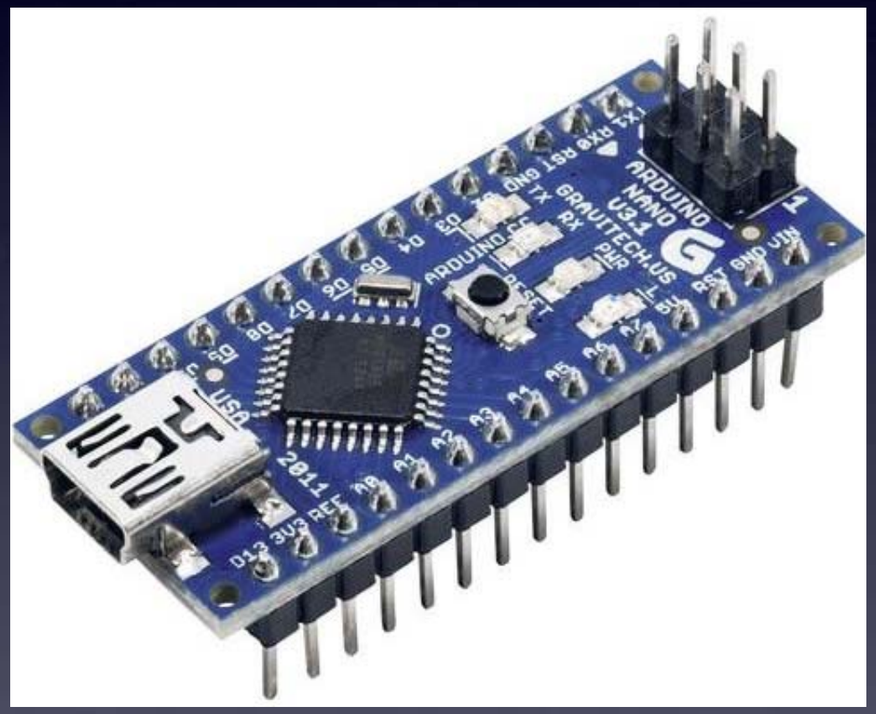


Nano clone

We can
connect parts to our Arduino,
and program it!

USB-Serial Cable Driver





You may need to download and install a Serial Port driver
for your Operating System (Windows, MacOS, or Linux)

Helpful info
on the
Arduino for(4) Total Newbies

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workshop
web-page:

https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop.php

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take control

At Cornfield Electronics we create devices that give people opportunities for effective choices in their lives.
Each of us can decide whether to watch TV monitors, and when to watch. Each of us can decide when to get the rest we want, and how we dream. Everyone can learn to make cool things with our kits. Please explore our products, make your own choices, and see how *your* life can be enhanced.

join our mailing list

Love it or hate it, TV screens are all around us. TV-B-Gone® universal remote control is the first fruit of our technical savvy, embodying our belief in empowerment, and sense of humor. This universal remote control fits in your pocket and allows you to discreetly turn TVs off wherever you go. TV-B-Gone fans around the world are using it for a variety of practical, philosophical, and humorous purposes. Imagine the possibilities...

Years in the making NeuroDreamer sleep mask is another of our personal empowerment inventions. We all need rest, but we don't always get it in our busy lives. NeuroDreamer sleep mask lets you use your own brainwaves to bring you the rest you need. And with the **lucid dreaming model**, you can take control of your dreams.

Want to learn electronics? We make way cool, fun, intriguing, educational kits that **anyone can make**! Our most **POPULAR** kits are: ArduTouch music synthesizer kit and TV-B-Gone kit!

We make truly useful technological solutions that put you in charge.

Welcome to our better world!

NOTE: As of 14-Feb-2023 Cornfield Electronics is a sole proprietorship of Mitch Altman.

DO-IT-YOURSELF PROJECTS

by Mitch Altman, and friends.
Last modified: 5-Oct-2022

You Can Make Cool Things With Electronics!

The projects on this page were all created for total beginners, with no experience,
so everyone can complete them successfully at my workshops, or at home, or anywhere!

All you need is:
a desire, a handful of parts, a soldering iron (with stand and sponge), a wire-cutter, a wire-stripper, solder, and an afternoon.

Here is a really nice tutorial on how to solder -- for total beginners!
Soldering Tutorial for total beginners

Open Hardware!

Everything on this page (and everything I do) is free and open source!
(That's *free* as in *freedom*.)
(But everything here is free to download -- and that is *free* as in *beer*.)
If you have any questions on anything, please feel free to email me:
mitch AT CornfieldElectronics DOT com

open source hardware

Soldering!

Soldering is fun! And it is easy! Really, it is!
I have taught tens of thousands of people around the world how to solder.
Everyone can do it! All ages, all skill levels.
People who have never even sewn a button can easily learn to solder. Even you!
Once you learn how to make one good solder connection, you can make anything on this page.
And if you can make anything on this page, you can learn to make anything with electronics and microcontrollers.

scroll down

Project: Make your own open source TV-B-Gone Kit (developed with Ladayada)

The TV-B-Gone Kit was originally developed from a MiniPOV3 hack (see below)
(which, of course, I hacked from my original TV-B-Gone.)

For excellent **assembly instructions**, please go to the TV-B-Gone Kit page of the of the Adafruit.com website.

For **questions** about the TV-B-Gone Kit, please go to the TV-B-Gone Kit user forum.
To see the **schematic, firmware, and board layout**, please go to TV-B-Gone Kit downloads.

TV-B-Gone Kits are available for **purchase** from the TVBGone.com website.

Project: Arduino For Total Newbies workshop
-- Learn Arduino, and make your own TV-B-Gone!

This workshop covers lots of ground -- all you need to learn how to play with Arduinos.
As an example project, you can make your own TV-B-Gone using Arduino.
Many thanks to Ken Shirriff for the original TV-B-Gone for Arduino project!
For documentation on this workshop, please see the:
Arduino For Total Newbies Workshop page.

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https://cornfieldelectronics.com/cfe/projects.php?PHPSESSID=ri5na5hblqup77t6odlps5sks4

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Arduino For Total Newbies Workshop

last updated: 1-May-2023

Learn how to make your own way cool projects with Arduino,
using TV-B-Gone as an example project to learn from.

I've given this workshop at Noisebridge hackerspace in San Francisco (several times), at 27C3 and 28C3 in Berlin, and 29C3, 30C3, 31C3, 32C3, and 33C3 in Hamburg, and at 34C3, 35C3, 36C3 in Leipzig, and RC3 online, at CCCamp2011 CCCamp2015 and CCCamp2019 outside of Berlin, at HeatSync Labs hackerspace in Phoenix, AZ, at Fabelier hackerspace in Paris, at Unit One in 2012, 2014, 2016, and 2018 as Hacker In Residence at the University of Illinois, in Urbana, IL, at Makerspace Urbana in Urbana, IL in 2012 and in 2016, at Workshop Weekend in Oakland, CA (twice), at XinCheJian hackerspace in Shanghai, at Maker Carnival in Beijing (twice) at several conferences and hackerspaces on my Hackers on a Train Workshop Tour 2012 including at HOPE Number 9 in New York City, at ToorCamp 2012 in Neah Bay, WA, at OHM 2013 and SHA 2017 outside of Amsterdam, at RockIT CoLabs in San Francisco, at BalcCon2k14 in Novi Sad, Serbia, at HOPE X, The Eleventh HOPE, The Circle of HOPE A New HOPE in New York City, and HOPE 2020 online, at the iCenter as Hacker In Residence at Tsingua Univeristy in Beijing, at EMF Camp 2016, EMF Camp 2018, and EMF Camp 2022, outside of London, at Tami hackerspace in Tel Aviv, at Le Wagon and Zhongxi in Chengdu, at Astralship hackerspace in North Wales (three times), at Open Source Microfactory Build Camp online, at Newline in Ghent, at GPN20 in Karlsruhe, at Fri3d Camp 2022 near Sint-Joris-Weert, Belgium, at Maker Faire Brno 2022 in Brno, Czech Republic, at HiP-Berlin in Berlin, Germany,
and lots of other places.

Each time 10 to 50 people show up. (Folks seem to like it.)

Itinerary for Arduino For Total Newbies Workshop:

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https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop.php

Stuff to download

Here is what is available for downloading for the Arduino For Total Newbies Workshop:

1) If you don't already have **Arduino software** you need to download it for your computer (Windows, Mac OS, or Linux):
Arduino download page

2) You need a **driver for your USB communications/programming cable**. Several different ones are available. Choose the driver for the cable you have and the operating system for your computer.

Samurai Circuits board (SiLabs CP210x USB-to-Serial TTL) drivers:
The latest drivers from SiLabs' website
The SiLabs driver is installed by default on most Linux systems.

Adafruit FTDI Friend drivers:
The latest drivers from FTDI's website
The FTDI driver is installed by default on most Linux systems.

FTDI Cable drivers:
The latest drivers from FTDI's website
The FTDI driver is installed by default on most Linux systems.

3) You also need the **TV-B-Gone Arduino Sketch** (download this, unzip it, and copy it to your computer in the "examples" folder inside your "arduino" folder that you downloaded):
TV-B-Gone Arduino sketch*(22KB)*

4) **Schematic Diagram for Arduino TV-B-Gone remote control:**
Schematic Diagram*(449KB)*

Parts List for Arduino TV-B-Gone remote control:
Parts List (Open Office)*(12KB)*
Parts List (MS Office)*(9KB)*

Schematics for the U-Do-It-Duino Arduino clone kit:
U-Do-It-Duino schematic *(110KB)*

Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:
U-Do-It-Duino complete assembly instructions

scroll down

tvbg_arduino_workshop.php

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https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop.php

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U-Do-It-Duino schematic *(110KB)*

Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:

U-Do-It-Duino complete assembly instructions

Soldering Is Easy comic book:

Solder Comic (English) *(809KB)*
Many other languages are available!

Here are links to the slides I use in the workshop:

Arduino For Total Newbies workshop slides (with U-Do-It-Duino kit) *(69.2MB)*

Arduino For Total Newbies workshop slides (with Arduino Uno -- no soldering) (56.0MB)

Slides for this workshop

scroll down

1) If you don't already have **Arduino software** you need to download it for your computer (Windows, Mac OS, or Linux):

Arduino download page

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https://www.arduino.cc/en/Main/Software

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ARDUINO WEB EDITOR

Start coding online with the Arduino Web Editor, save your sketches in the cloud, and always have the most up-to-date version of the IDE, including all the contributed libraries and support for new Arduino boards.

GETTING STARTED

CODE ONLINE

Download the Arduino IDE

Windows Installer, for Windows XP and up

Windows ZIP file for non admin install

2) You need a **driver for your USB communications/programming cable.** Several different ones are available. Choose the driver for the cable you have and the operating system for your computer.

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https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-

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CP210x USB to UART Bridge VCP Drivers

The CP210x USB to UART Bridge Virtual COM Port (VCP) drivers are required for device operation as a Virtual COM Port to facilitate host communication with CP210x products. These devices can also interface to a host using the direct access driver. These drivers are static examples detailed in application note 197: The Serial Communications Guide for the CP210x, download an example below:

AN197: The Serial Communications Guide for the CP210x

Download Software

The CP210x Manufacturing DLL and Runtime DLL have been updated and must be used with v6.0 and later of the CP210x Windows VCP Driver. Application Note Software downloads affected are AN144SW.zip, AN205SW.zip and AN223SW.zip. If you are using a 5.x driver and need support you can download archived Application Note Software.

Legacy OS software and driver package download links and support information ›

Download for Windows 10 Universal (v10.1.4)

community.silabs.com/t5/Interface-Knowledge-Base/Legacy-OS-Software-and-Driver-Packages/ta-p/182585

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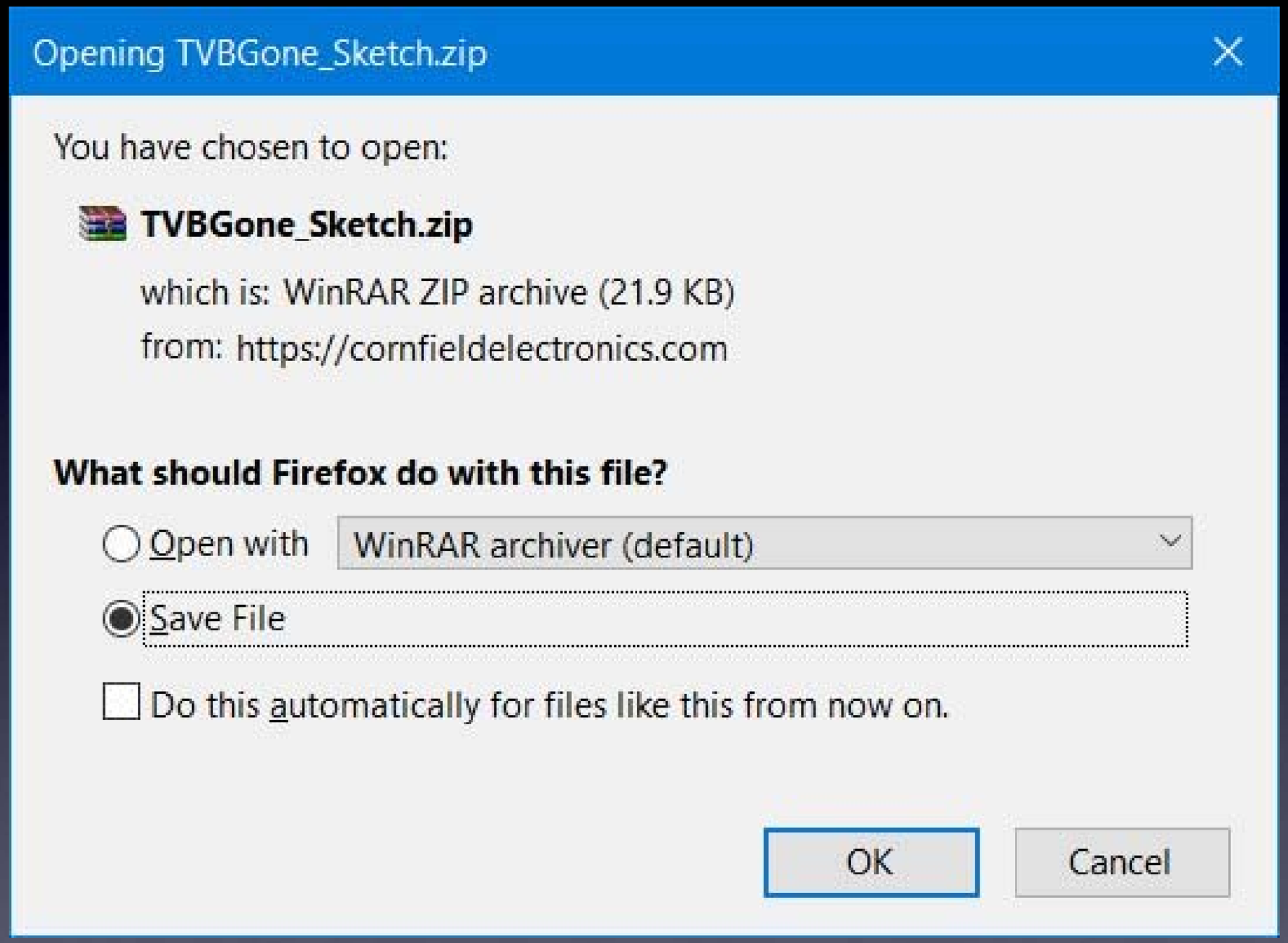

4) Schematic Diagram for Arduino TV-B-Gone remote control:
Schematic Diagram*(449KB)*

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Cornfield Electronics :: Projects | Cornfield Electronics :: Arduino | arduino_tvbgone_schematic.pd

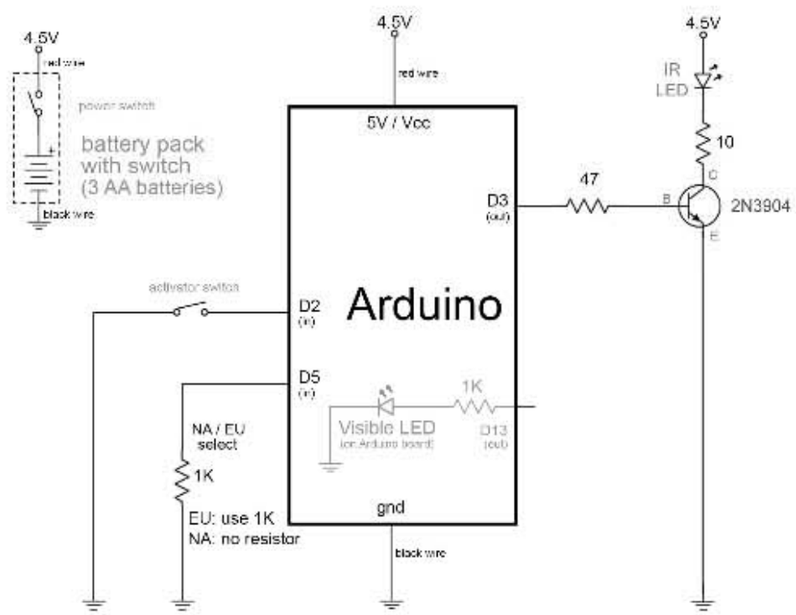
https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/arduino_tvbgone_schematic.pd

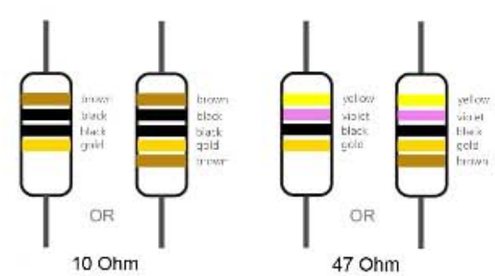
1 of 1 70%

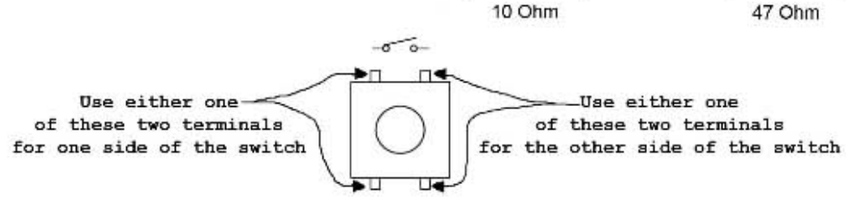
Arduino For Total Newbies

4-Sep-2015

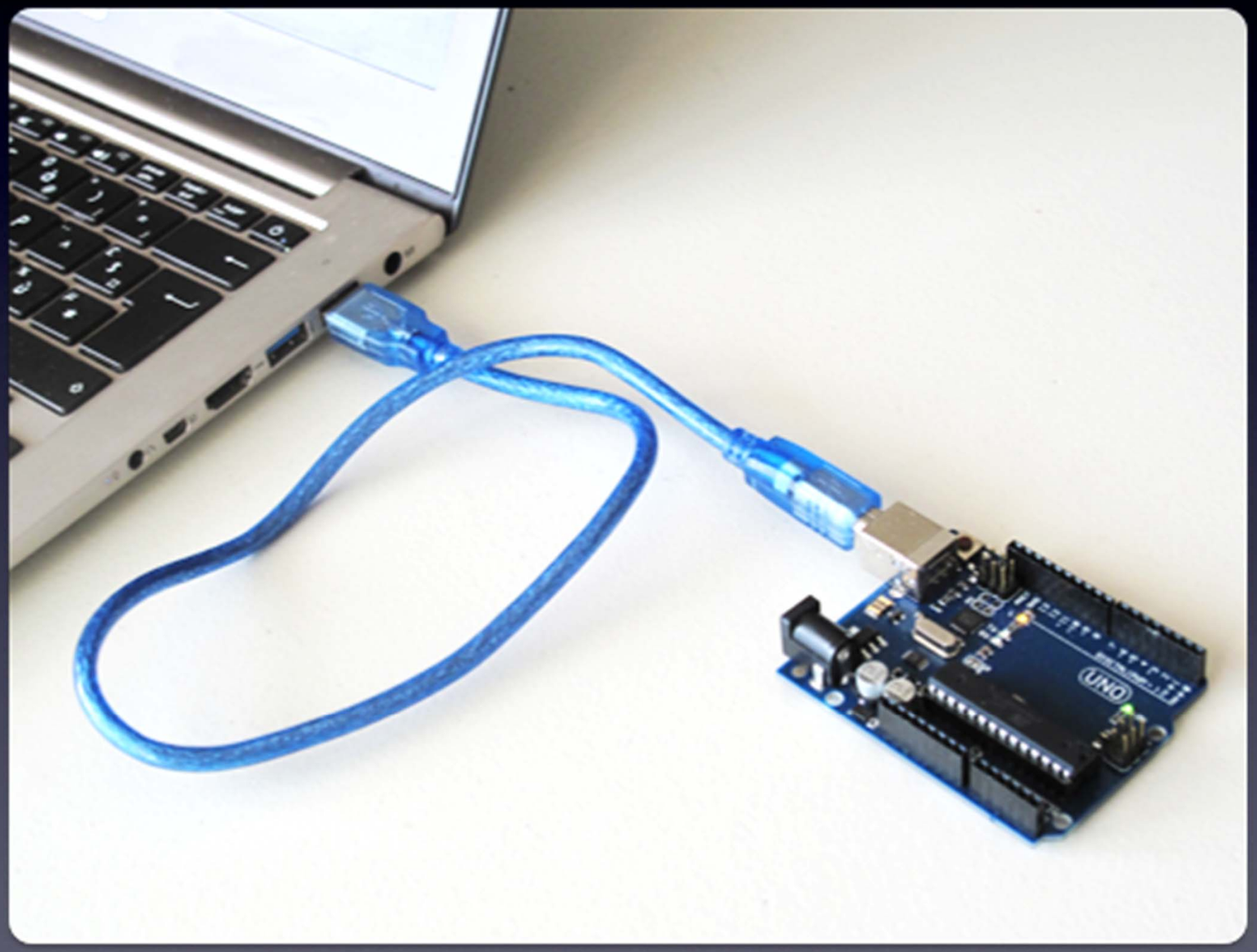
Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limore Fried (firmware modifications, kit design)
Ken Shirriff (original modifications for Arduino)
Johannes Schneemann (documentation)







Connect your Arduino to your computer



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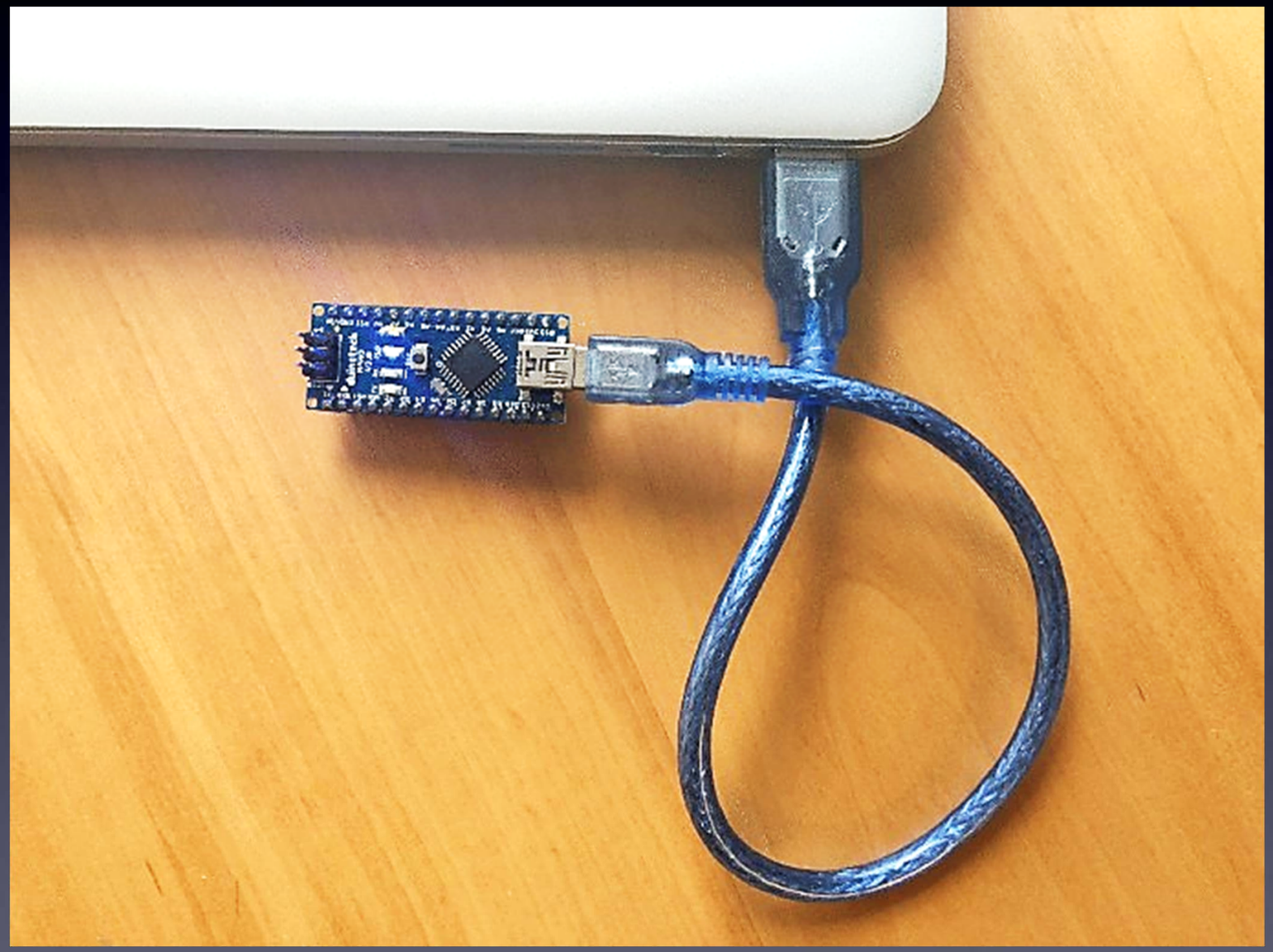
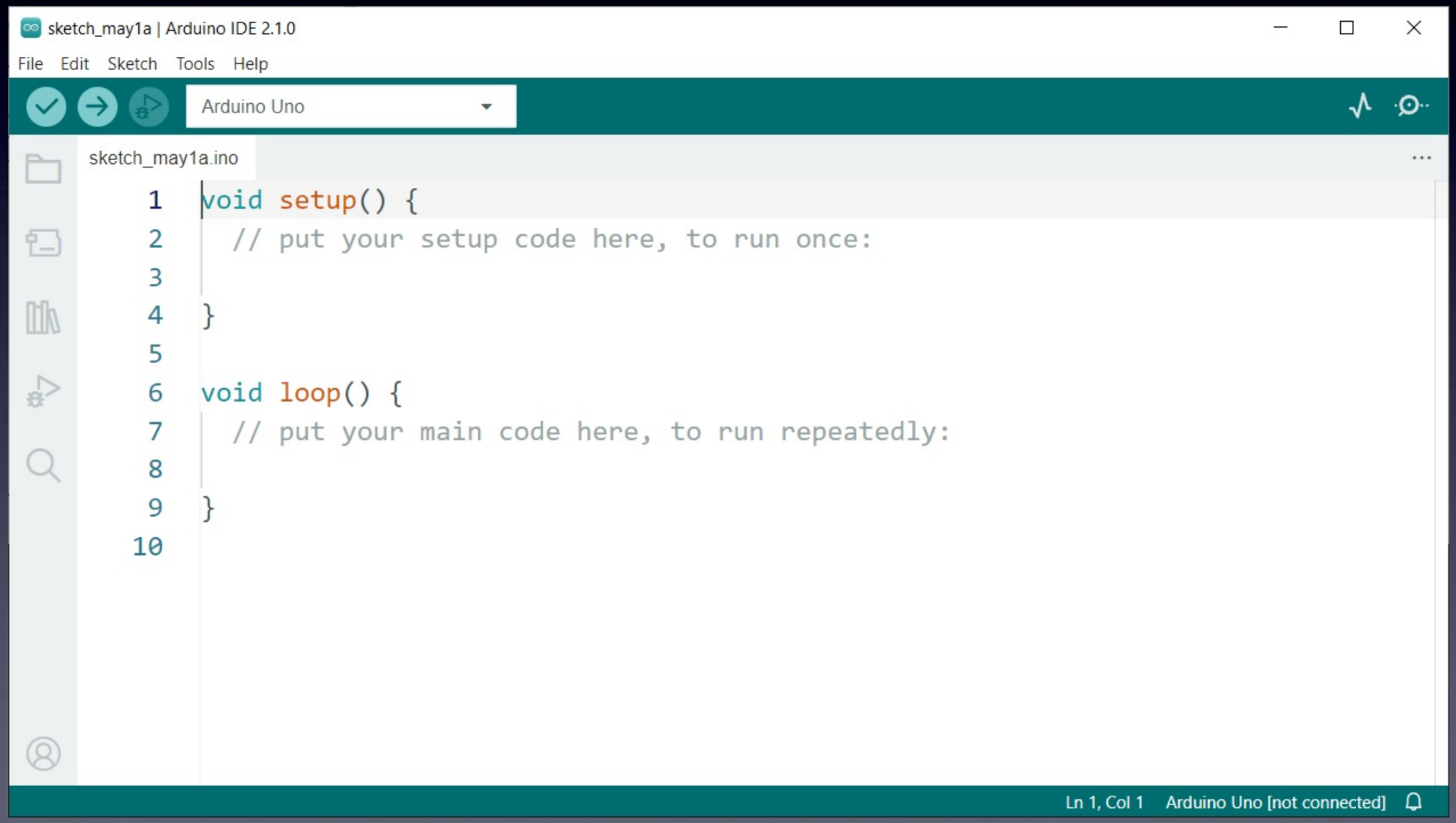


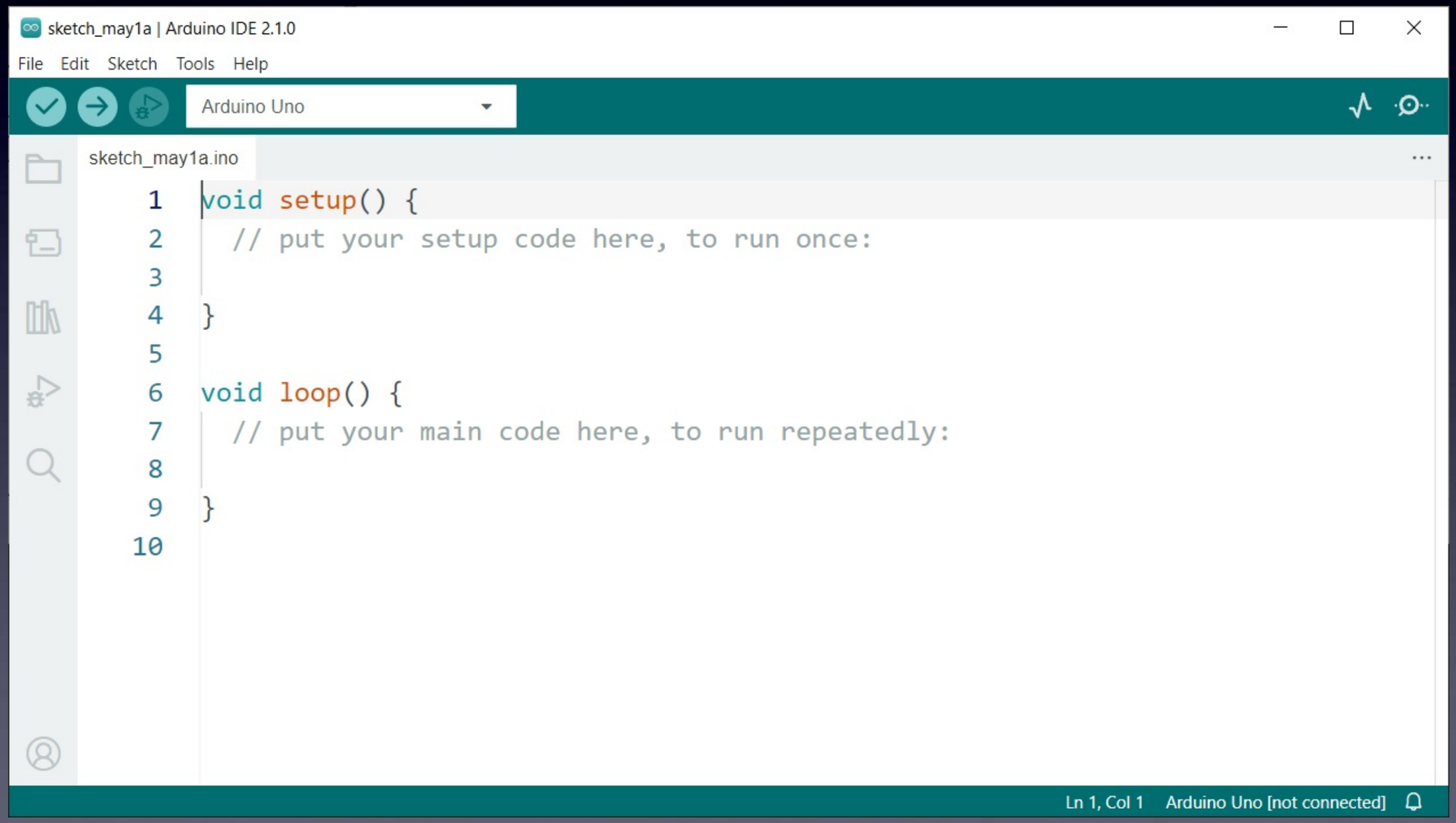
Arduino

After you download and install the Arduino software start it, and you will see a screen that looks like this:



Arduino

How to Set Up and Use the Arduino Software

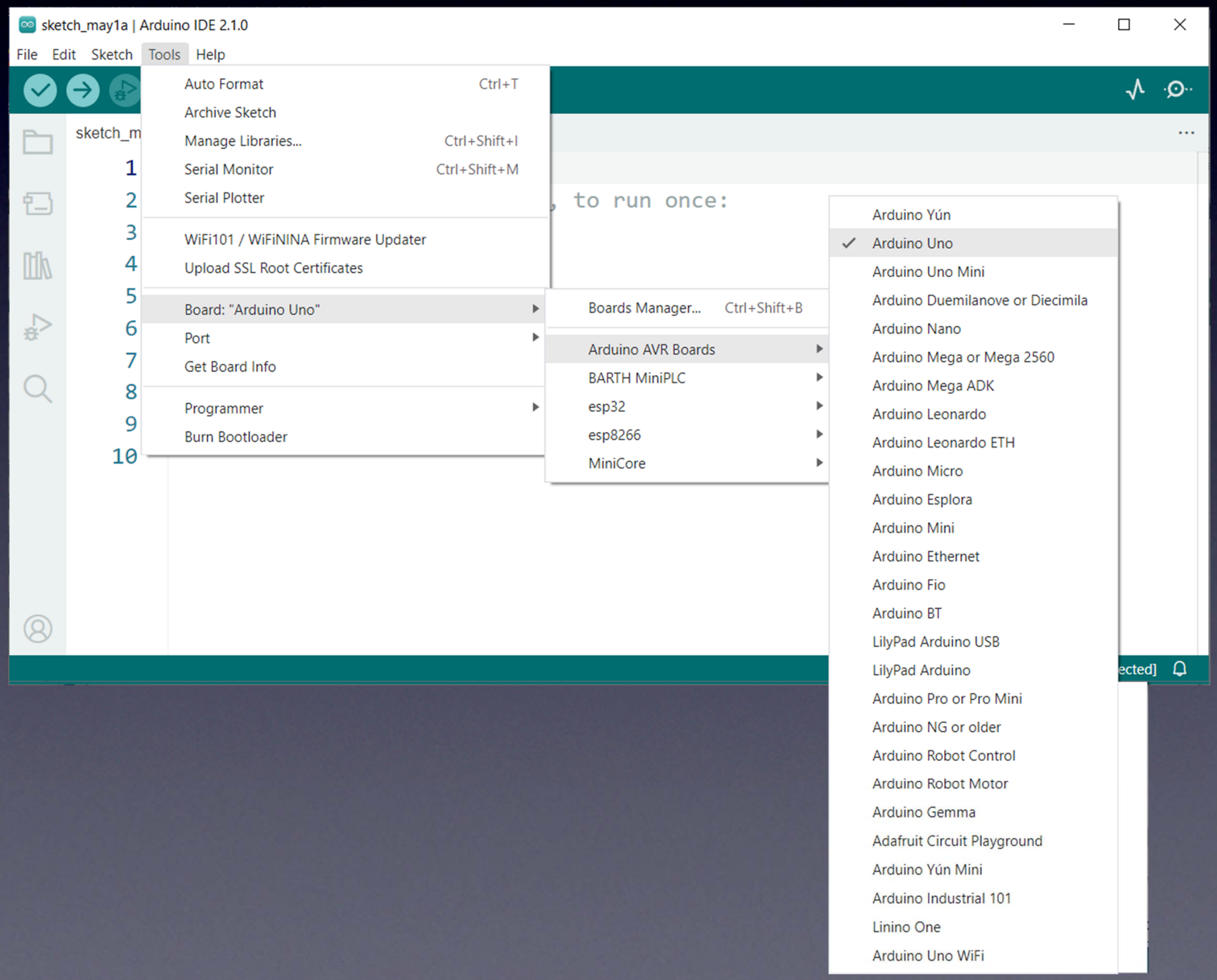


Arduino

The ***first time*** you start your Arduino software
you need to do ***two (or three) things*** to set things up:

(1)
Choose "Uno"
as the Board

(But,
if you have
a Nano board
then choose "Nano")



Arduino

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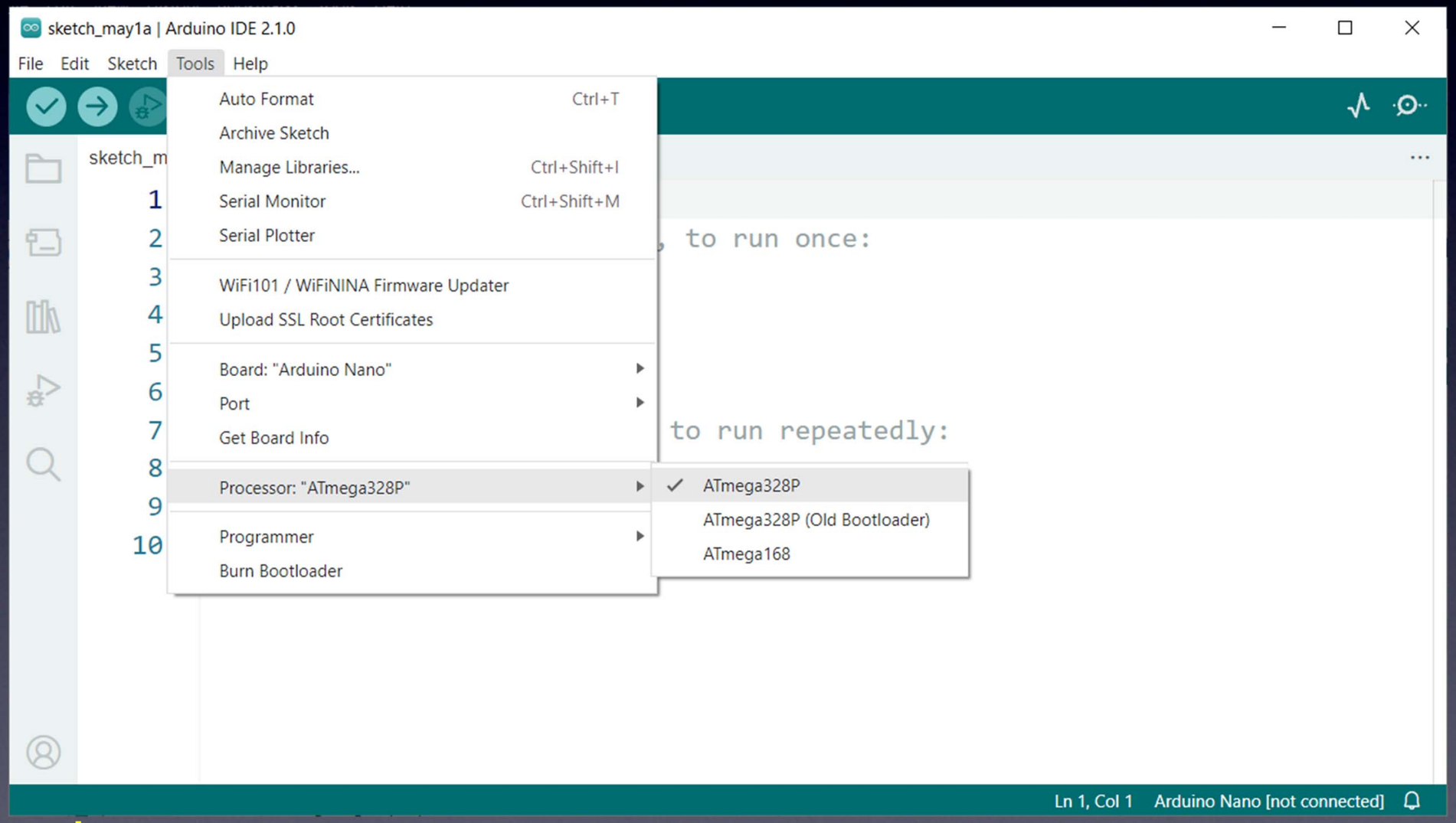
For Arduino Nano:

(1b)
Choose
your Processor



If this one doesn't work,
then
choose
"ATmega328P (Old Bootloader)"

Arduino

The ***first time*** you start your Arduino software
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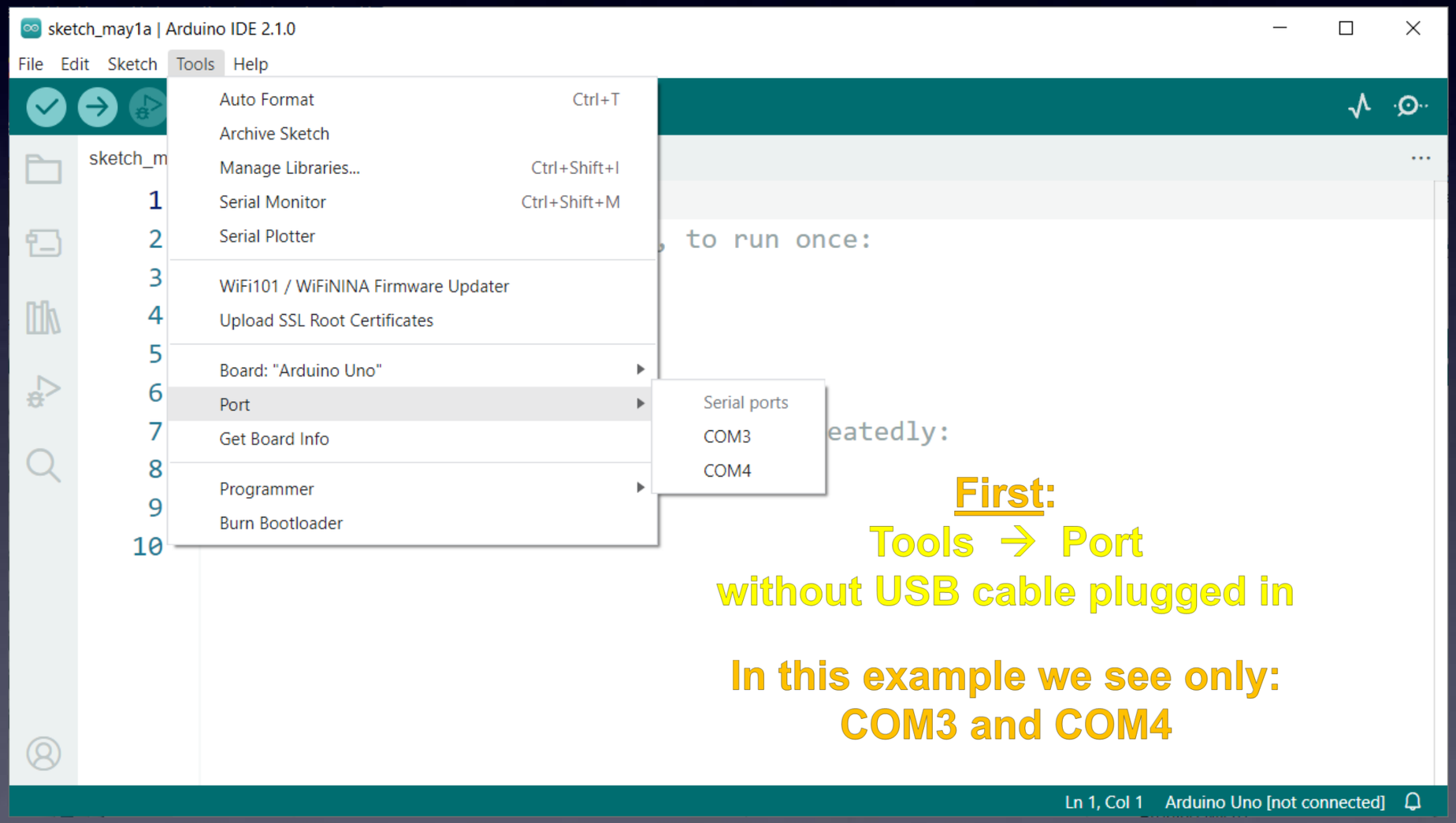
(2)
Choose the Port (this will be different depending on your Operating System)



First:
Tools → Port
without USB cable plugged in

In this example we see only:
COM3 and COM4

Arduino

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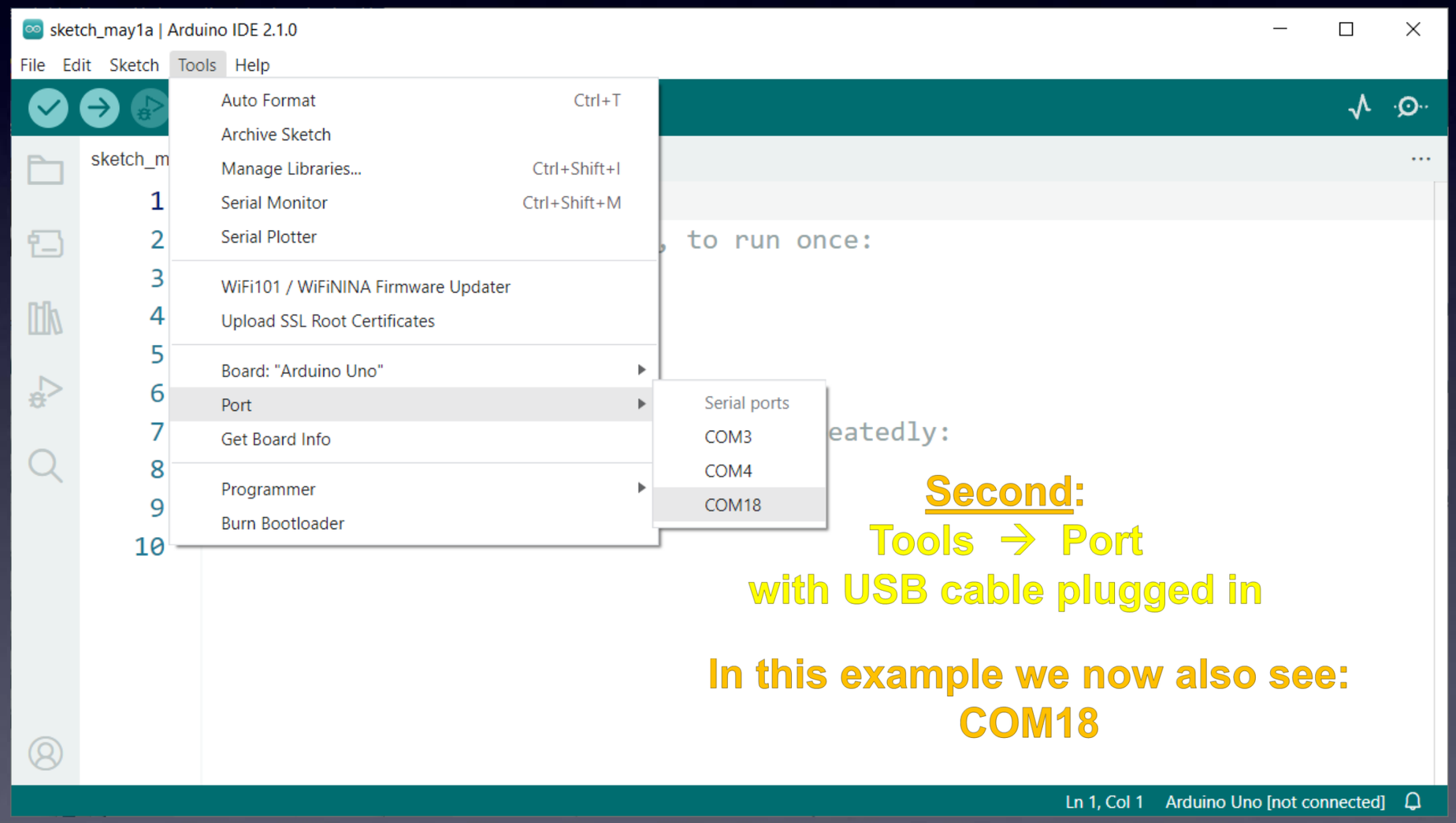
Choose the Port (this will be different depending on your Operating System)



Second:
Tools → Port
with USB cable plugged in

In this example we now also see: COM18

(After installing the driver for your USB-Serial cable and plugging it in your operating system will see a serial port and it appears here.)

Arduino

Your Arduino software is now ready to program your Arduino board !

sketch_may1a | Arduino IDE 2.1.0

File Edit Sketch Tools Help

Arduino Uno

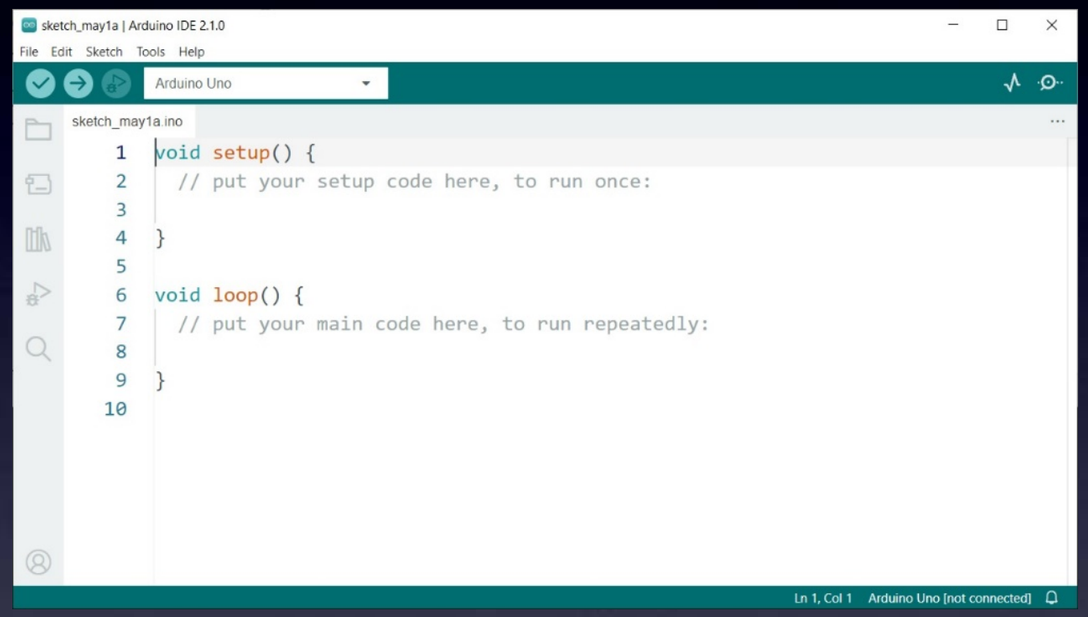
sketch_may1a.ino

```
1  void setup() {
2    // put your setup code here, to run once:
3
4  }
5
6  void loop() {
7    // put your main code here, to run repeatedly:
8
9  }
10
```

Ln 1, Col 1 Arduino Uno on COM18

Arduino

Designed for non-geeky artists

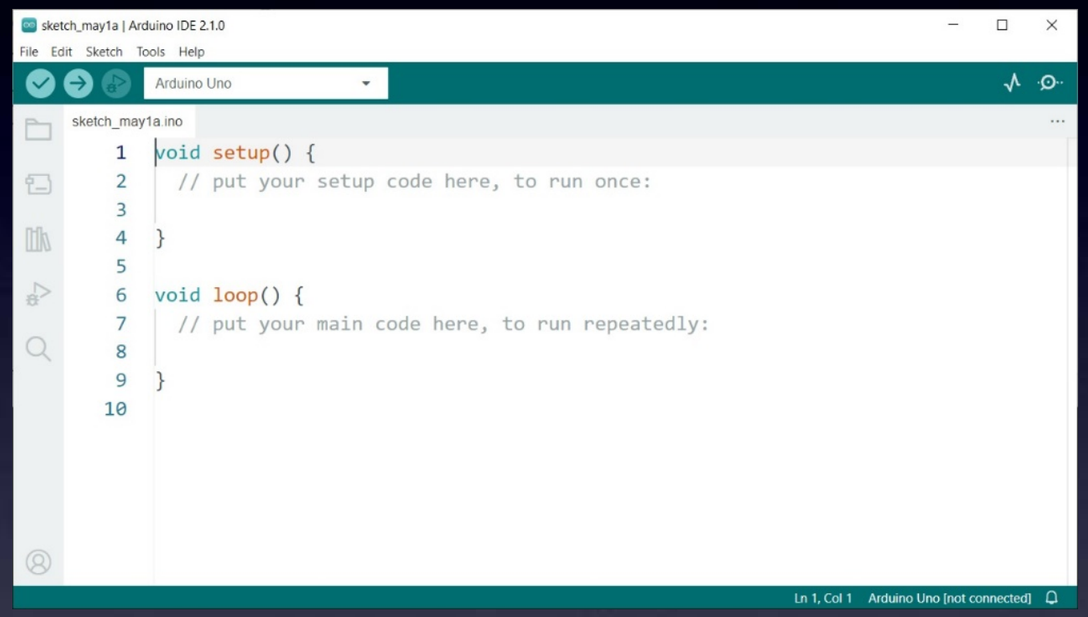


“Sketch” :

an Arduino program

Arduino

Designed for non-geeky artists



The Arduino language :

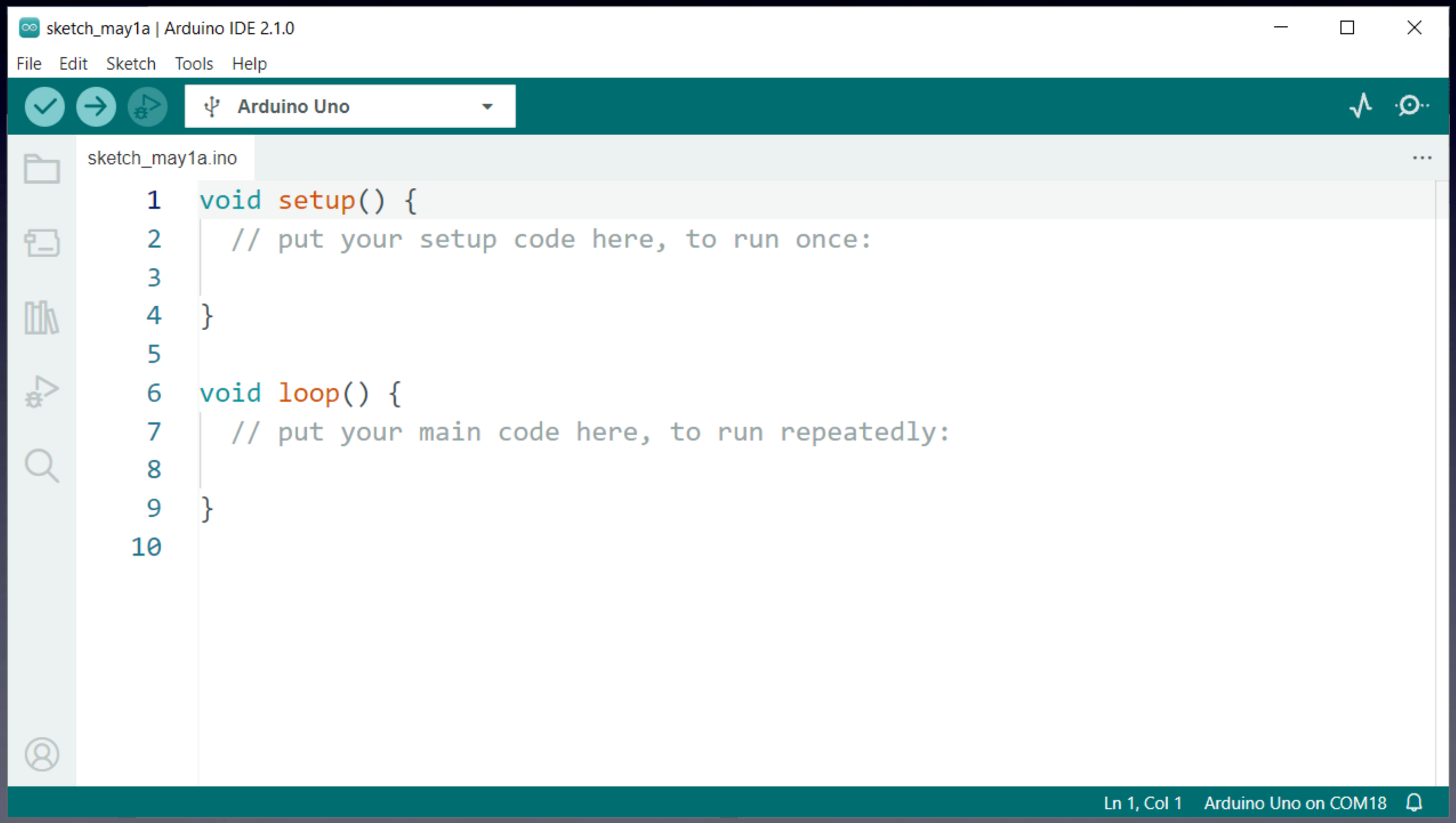
“Wiring”

(actually C/C++)

Arduino

Your Arduino software is now ready to program your Arduino board !

Let's make an LED blink! `Hello World`



Arduino

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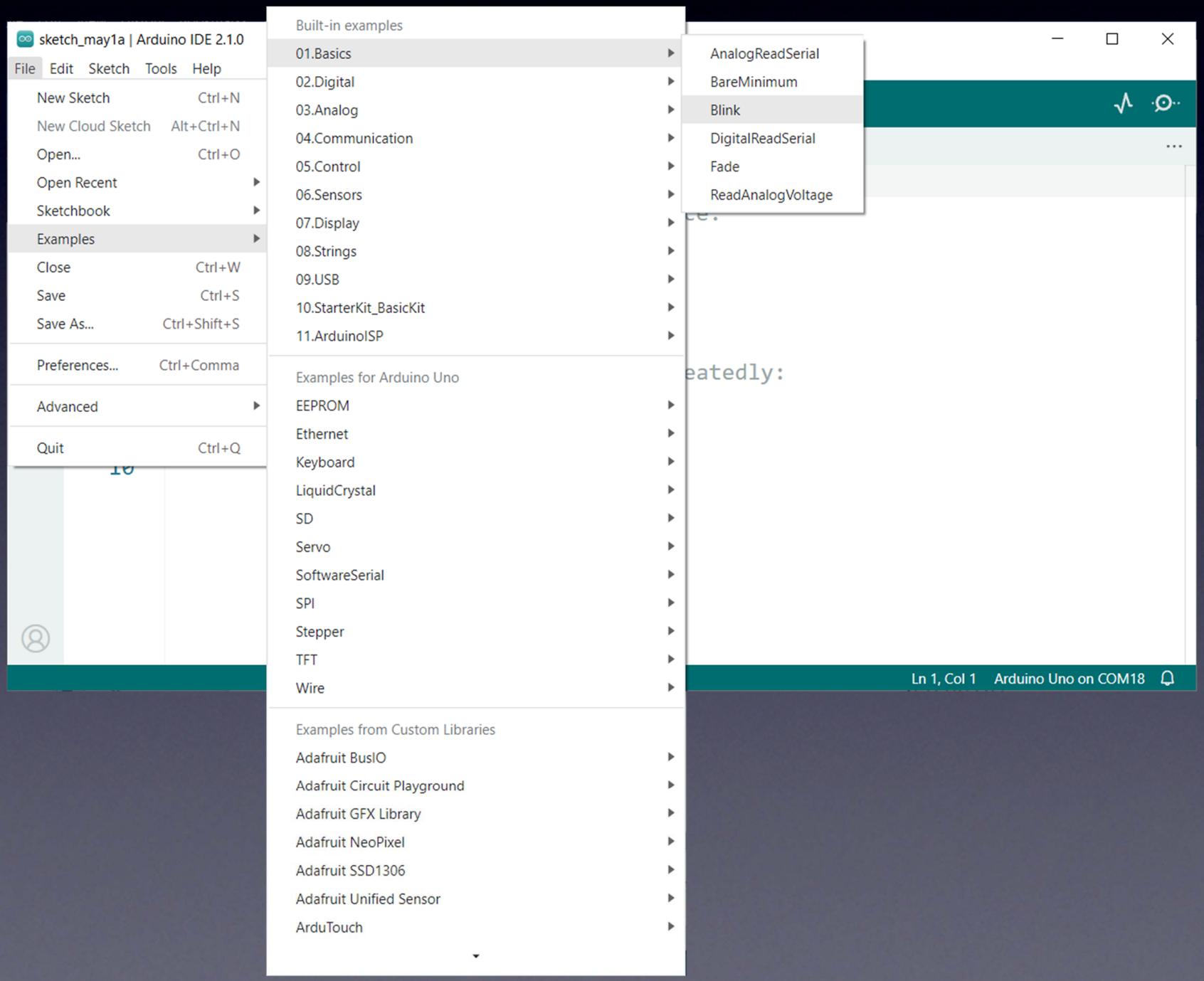

Arduino

Let’s make an LED blink! `Hello World`

Blink | Arduino IDE 2.1.0

File Edit Sketch Tools Help

Arduino Uno

Blink.ino

```
/*
  Blink

  Turns an LED on for one second, then off for one second, repeatedly.

  Most Arduinos have an on-board LED you can control. On the UNO, MEGA and ZERO
  it is attached to digital pin 13, on MKR1000 on pin 6. LED_BUILTIN is set to
  the correct LED pin independent of which board is used.
  If you want to know what pin the on-board LED is connected to on your Arduino
  model, check the Technical Specs of your board at:
  https://www.arduino.cc/en/Main/Products

  modified 8 May 2014
  by Scott Fitzgerald
  modified 2 Sep 2016
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink
*/
```

Ln 1, Col 1 Arduino Uno [not connected]

Arduino

Let's make an LED blink! `Hello World`

Blink | Arduino IDE 2.1.0

File Edit Sketch Tools Help

Arduino Uno

Blink.ino

```
modified 8 Sep 2016
by Colby Newman

This example code is in the public domain.

  https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink
*/

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage leve
  delay(1000);                      // wait for a second
  digitalWrite(LED_BUILTIN, LOW);   // turn the LED off by making the voltage LO
  delay(1000);                      // wait for a second
}
```

scroll down

Ln 1, Col 1 Arduino Uno [not connected]

How to Hack Arduino Programs (“Sketches”)

Blink | Arduino IDE 2.1.0

File Edit Sketch Tools Help

Arduino Uno

Blink.ino

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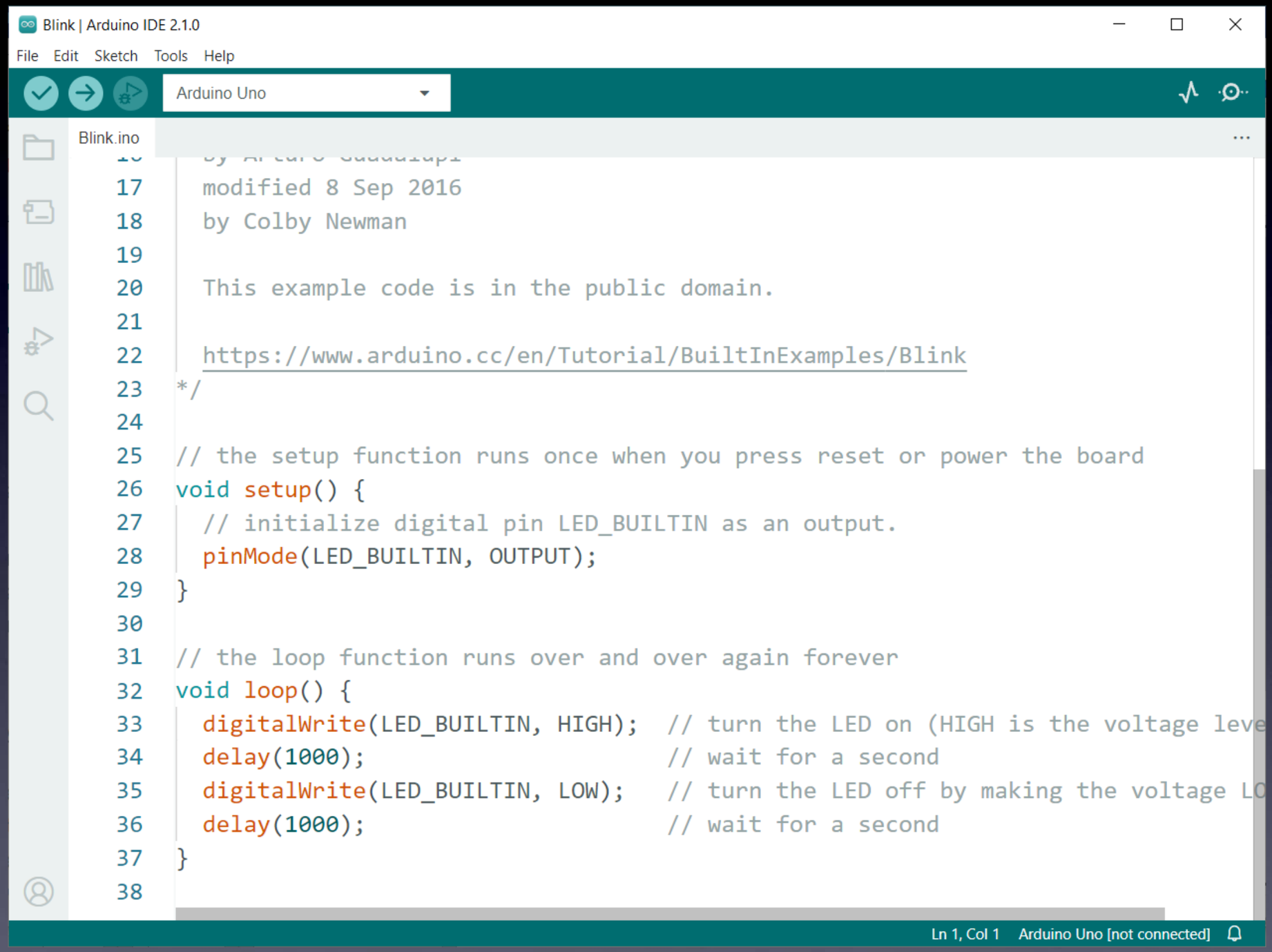
Ln 1, Col 1 Arduino Uno [not connected]

How to Hack Arduino Programs (“Sketches”)



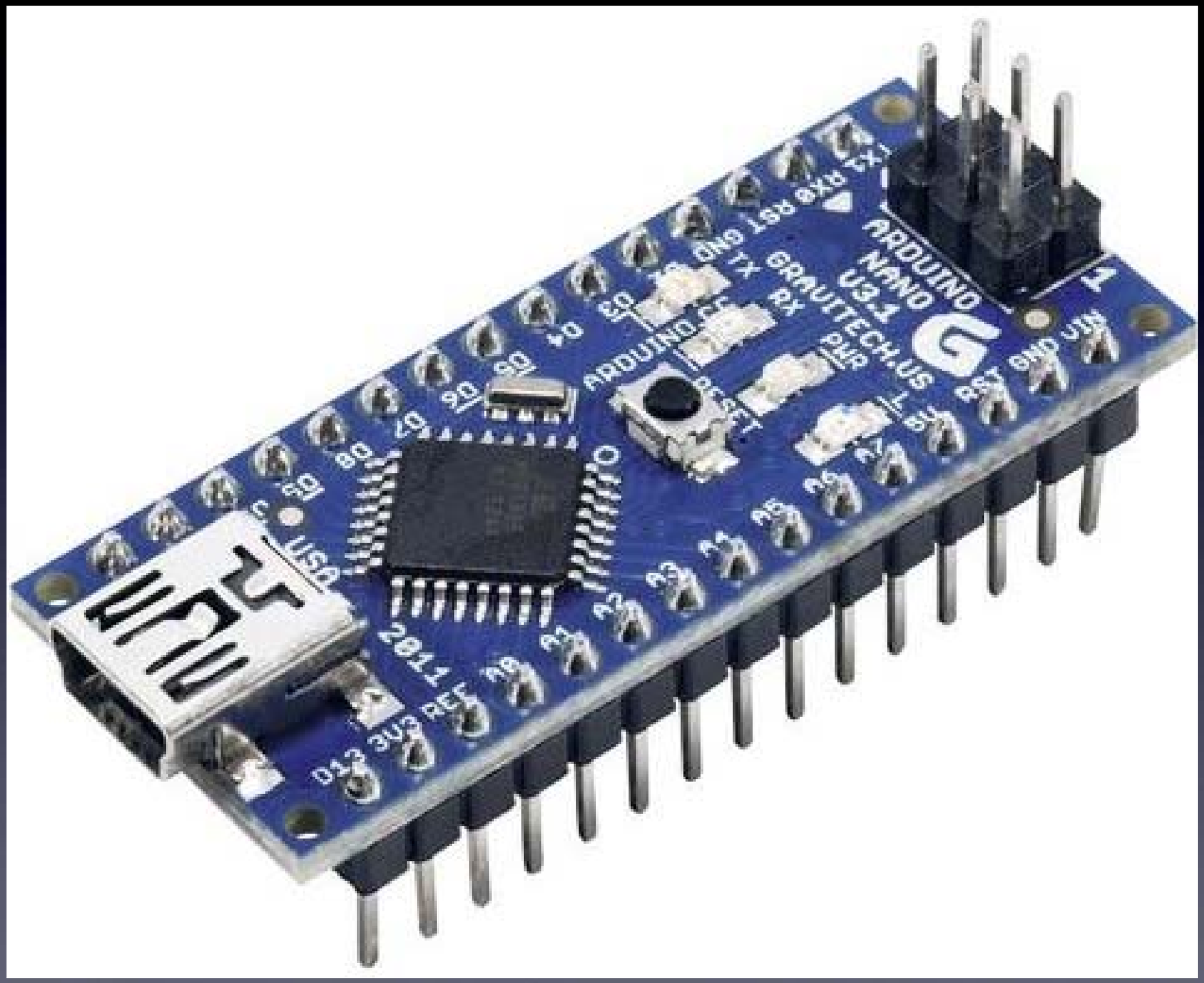
Many ways!

<u>Here are just a few</u>:

- Change blink rates
- External LED
- External motor
- External speaker
- External LED on Solderless breadboard
- More complex projects on Solderless breadboard

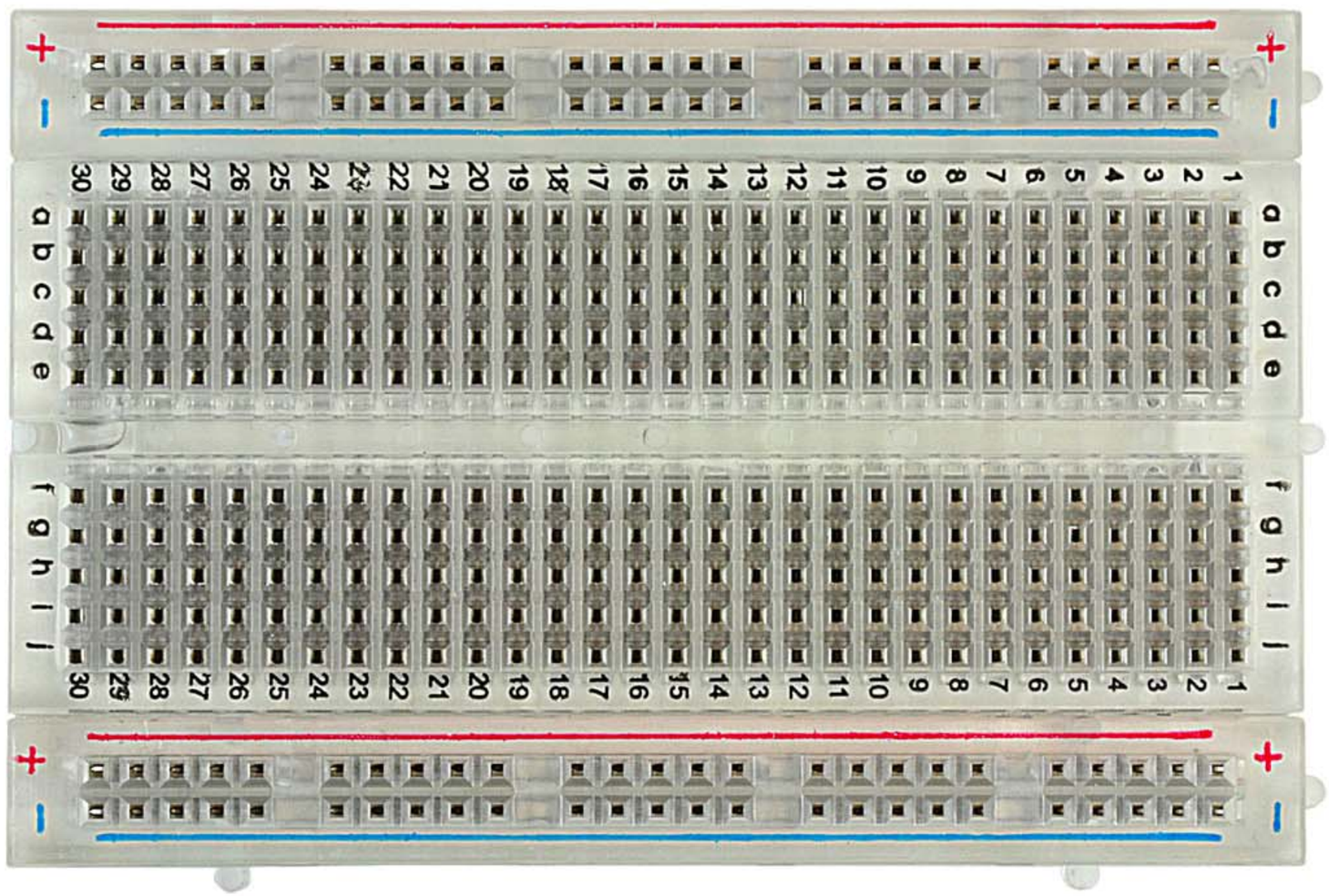
How to Hack Arduino Programs (“Sketches”)

How to Hack Arduino Programs (“Sketches”)

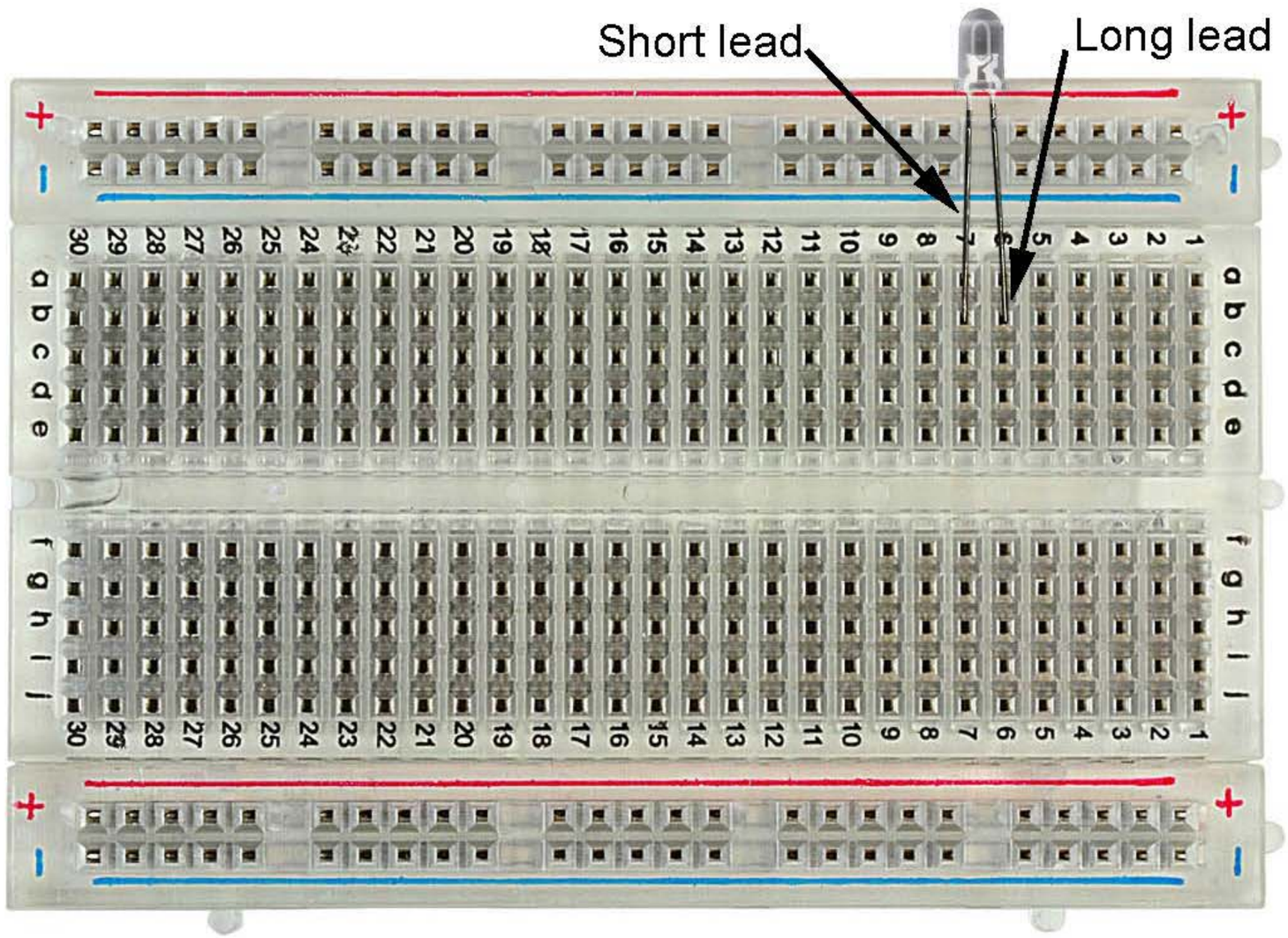


How to Use Solderless Breadboards

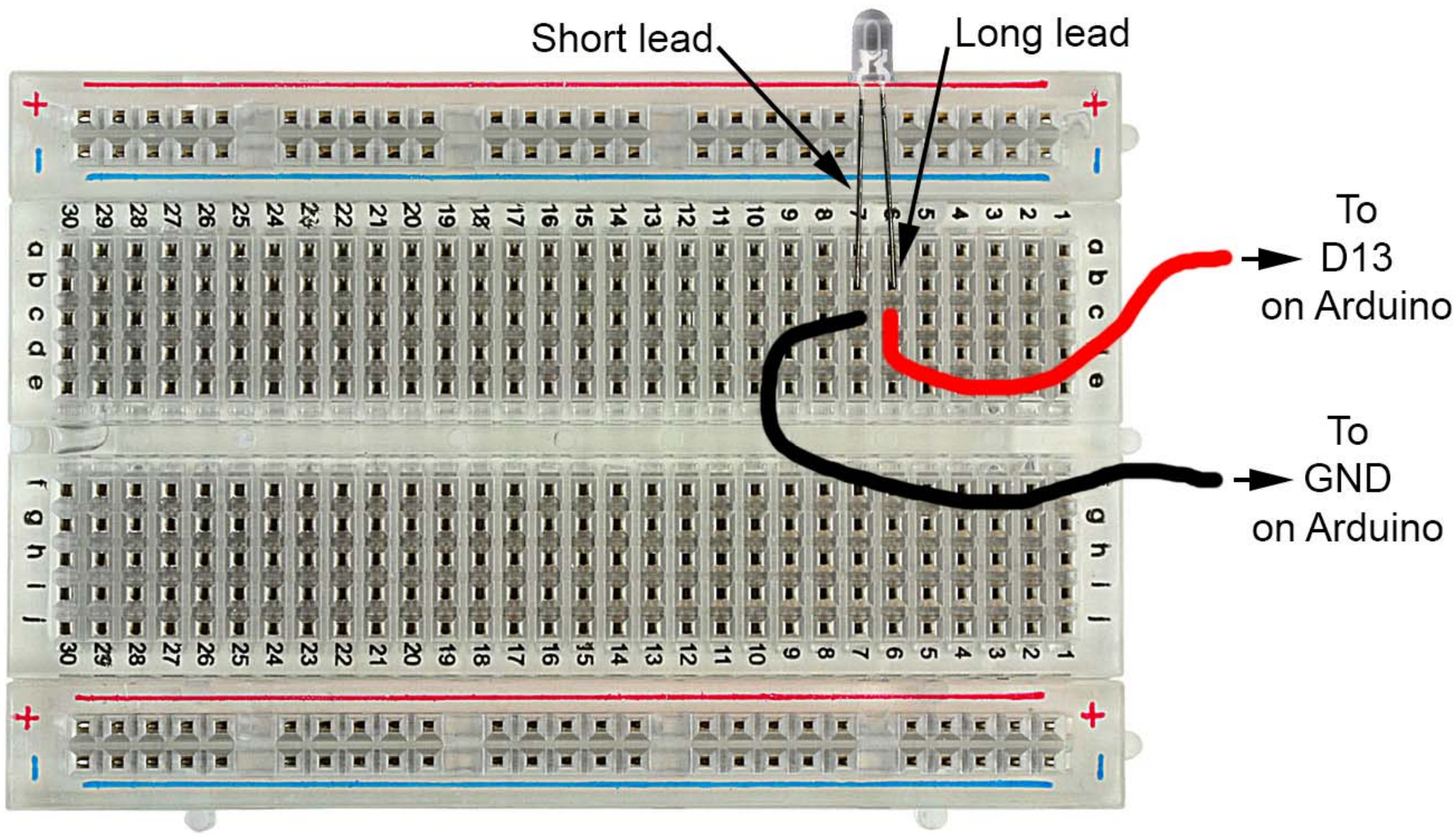
Solderless Breadboard



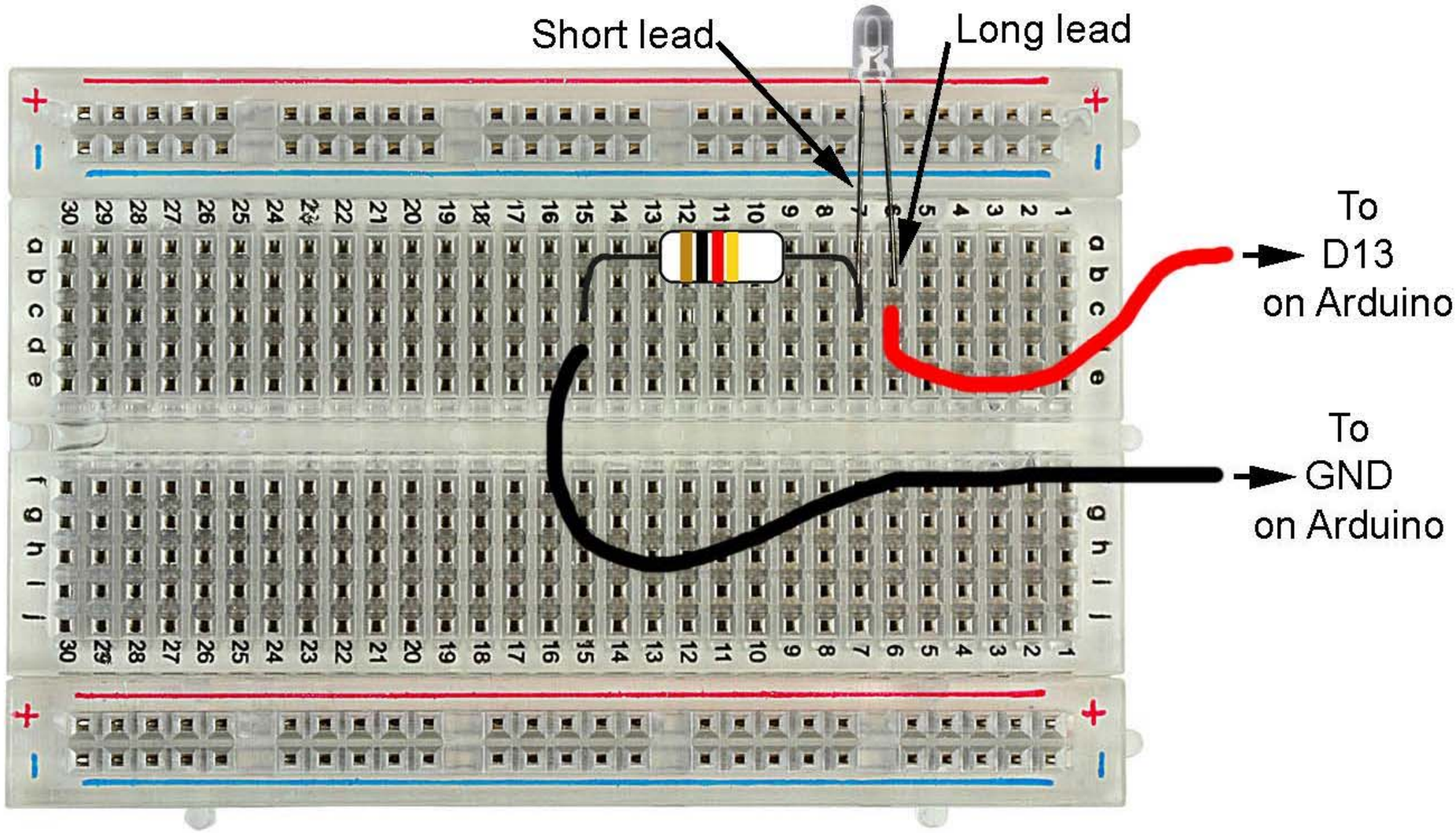
How to Use Solderless Breadboards



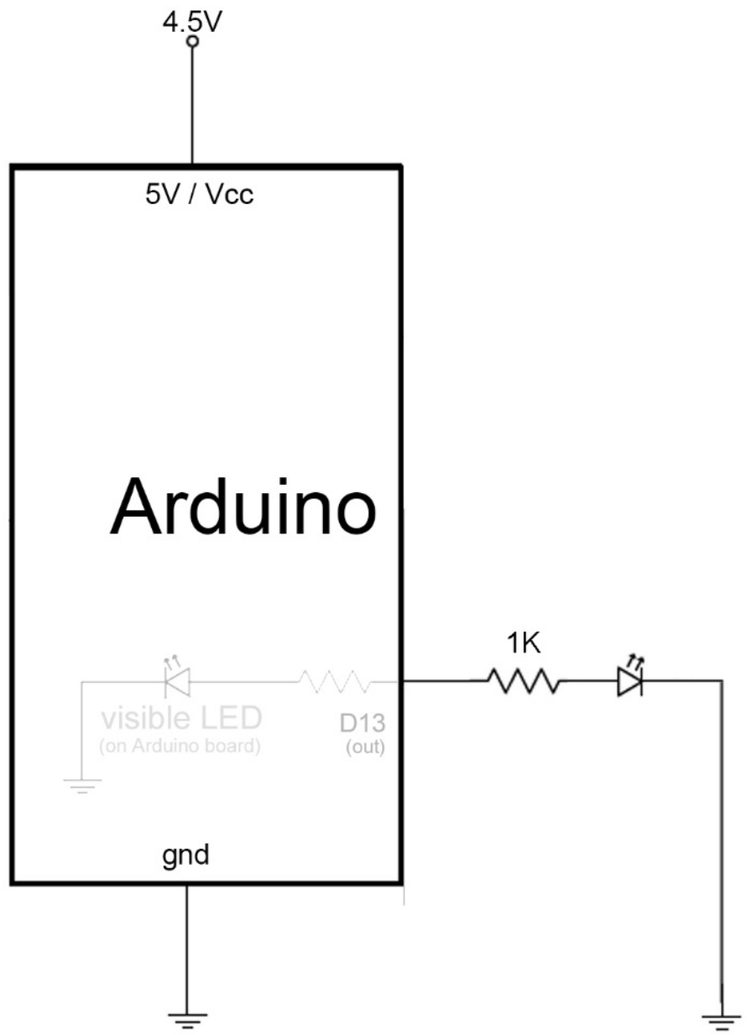
How to Use Solderless Breadboards



How to Use Solderless Breadboards



How to Read a Schematic

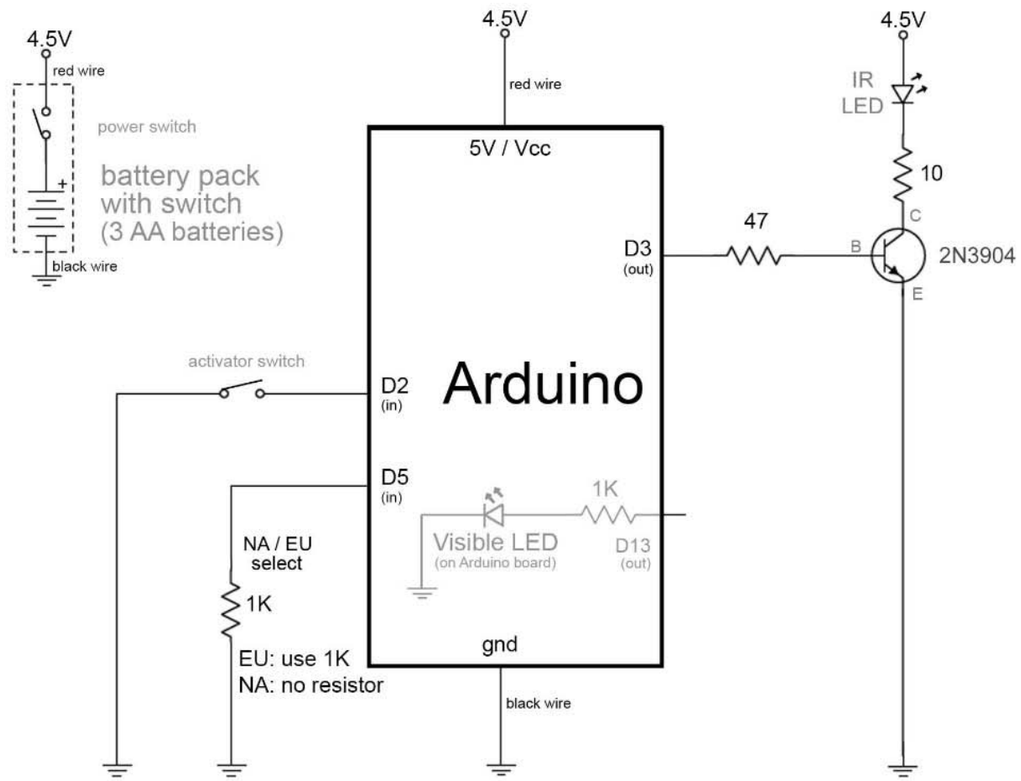


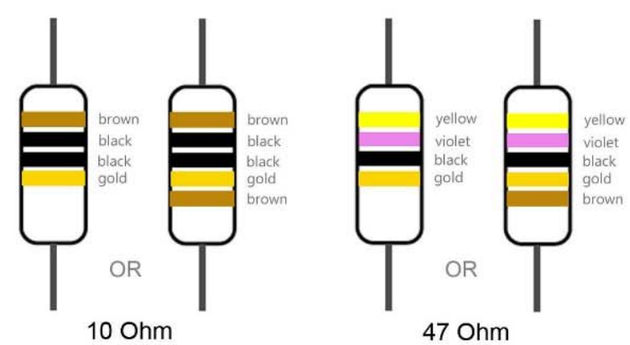
How to Read a Schematic

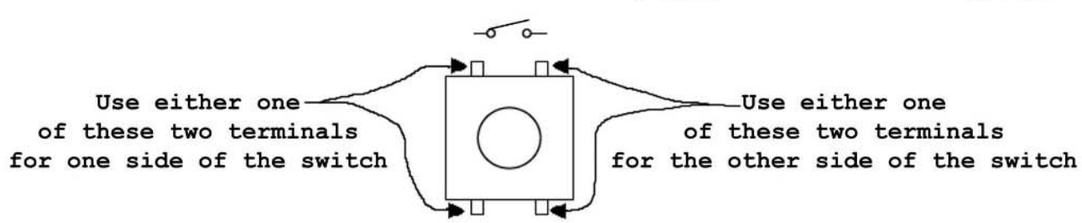
Arduino For Total Newbies

4-Sep-2015

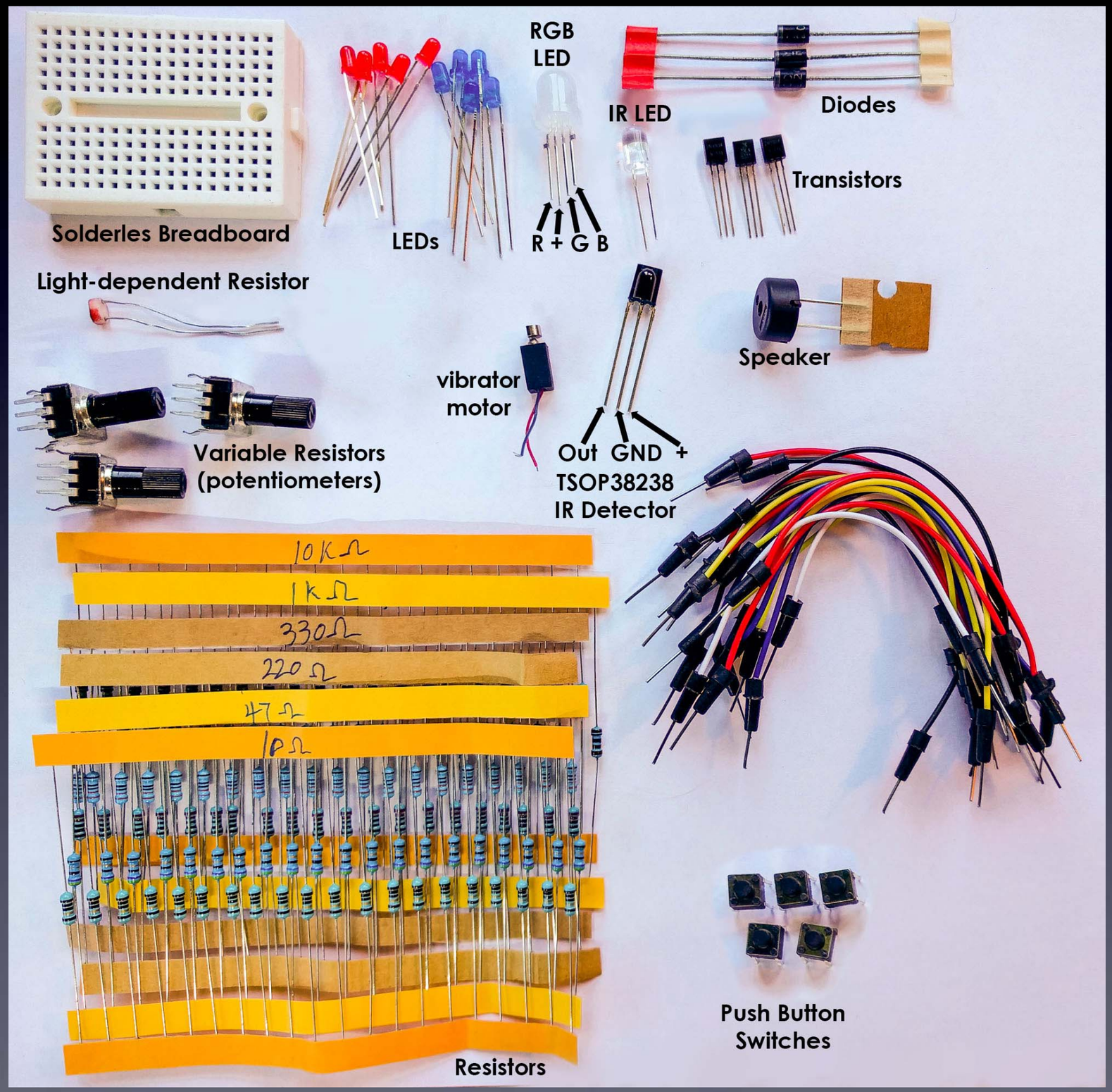
Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limore Fried (firmware modifications, kit design)
Ken Shirriff (original modifications for Arduino)
Johannes Schneemann (documentation)







Parts Pack Contents



Rev 10: 1-May-2023

Arduino For Total Newbies

w/ TV-B-Gone as example project

Mitch Altman

Chief Scientist, **Cornfield Electronics**, San Francisco, CA
Inventor of **TV-B-Gone** universal remote controls
Co-founder of **3Ware** (successful Silicon Valley startup)
Pioneer of **VR** (in the mid-1980s)
Founding mentor at **HAX** (1st and biggest hardware accelerator)
Co-founder of **Noisebridge** (San Francisco hackerspace)

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WeChat: **mitchaltman**