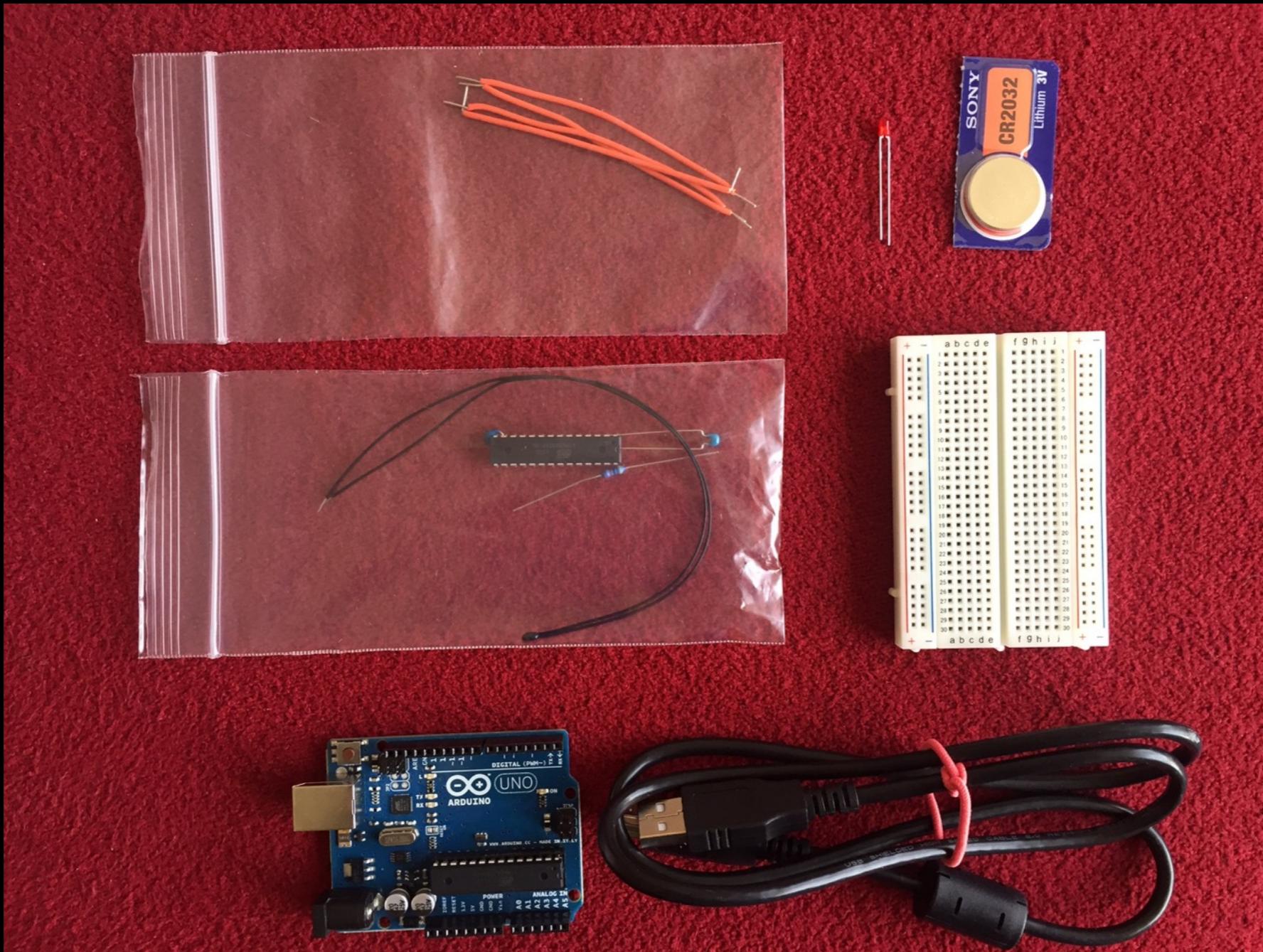


Playing with Arduino

John Keefe, WNYC Data News



slides at bit.ly/nicar-arduino

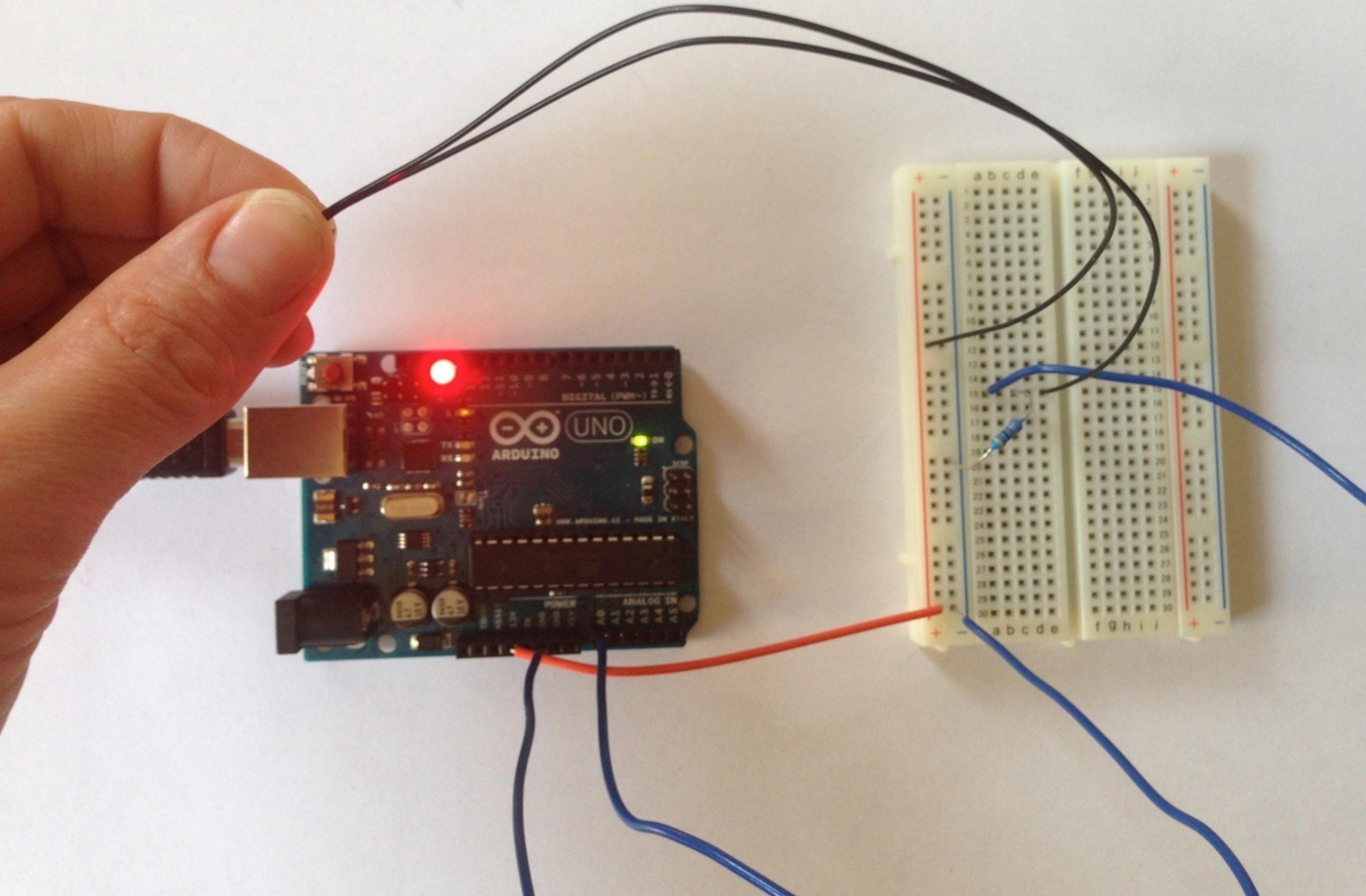
thanks to the
National Science
Foundation

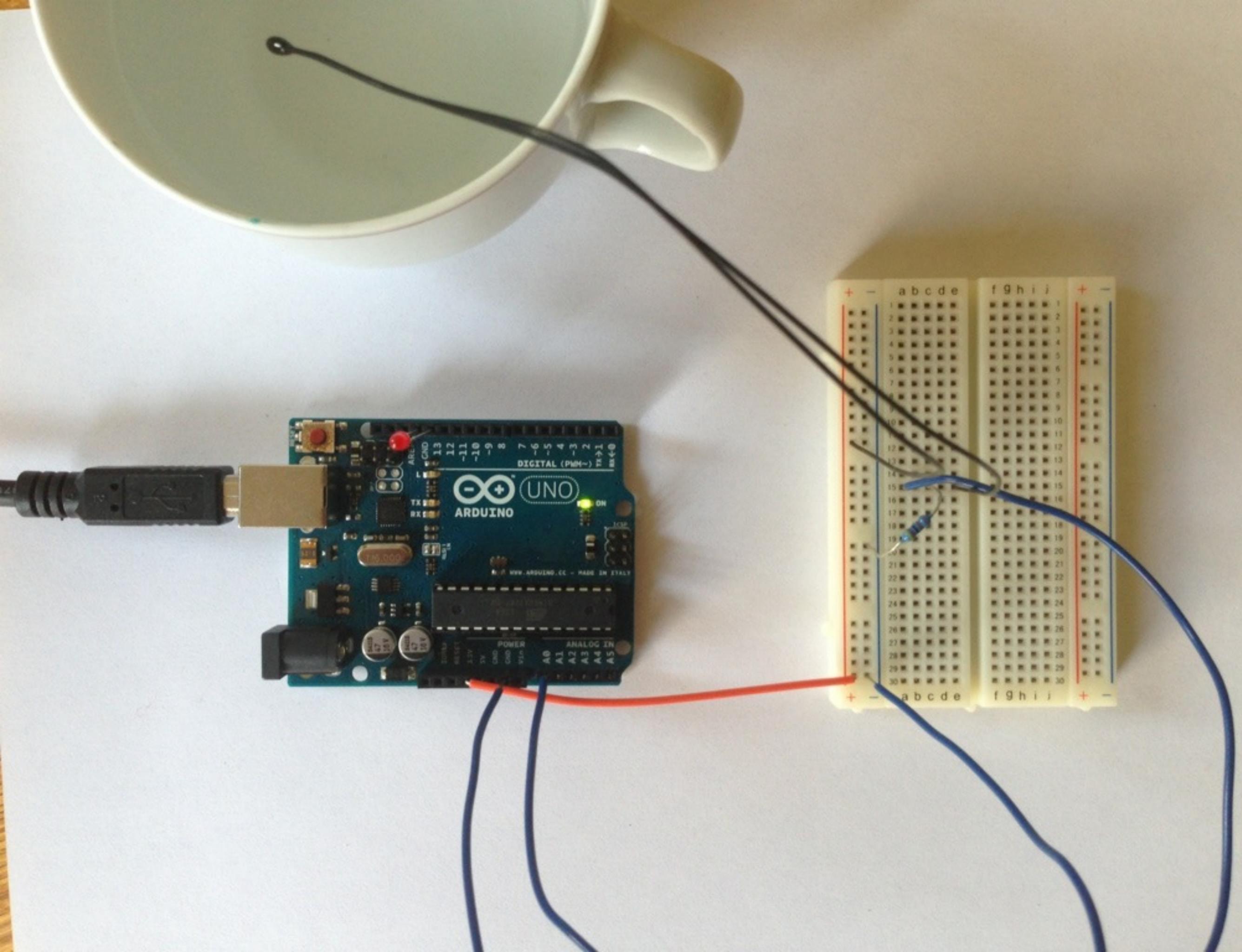


also thanks to
Liza Stark
thesoftcircuiteer.net

(all of the images are
by her!)

what are we
making?

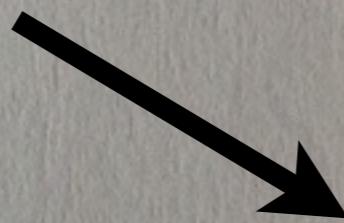




look at your LED.
what do you notice?

-

cathode



+

anode



always goes
to GROUND

always goes to
POWER or a PIN

put your LED and your
battery together.

-

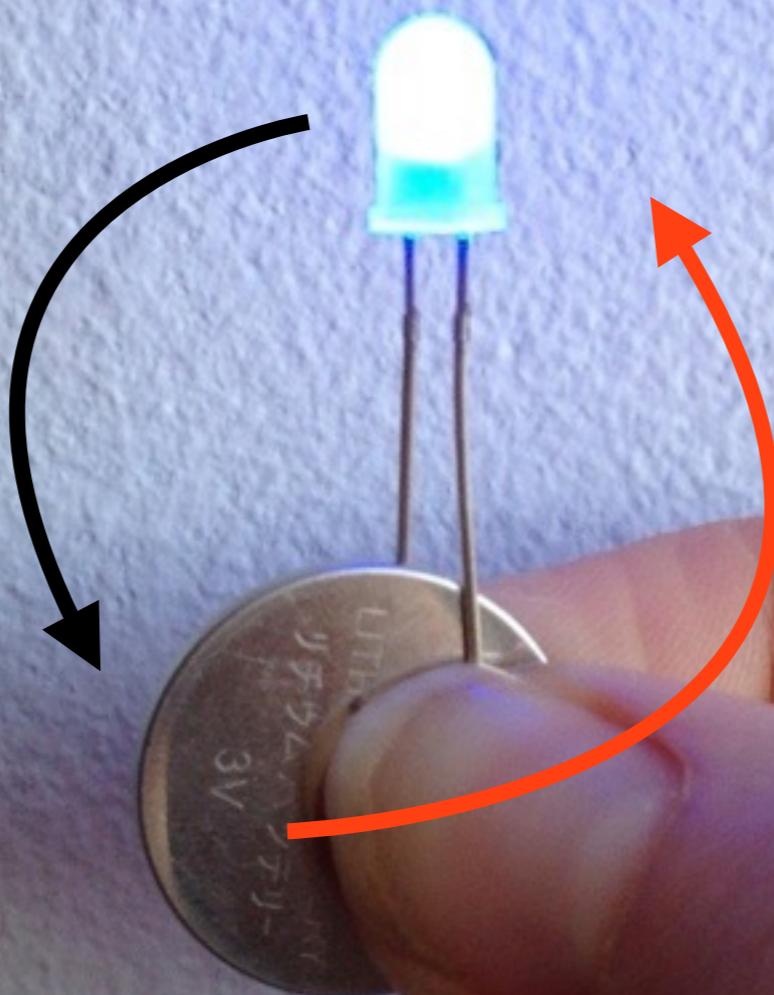
short leg



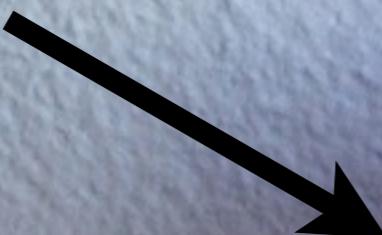
+

long
leg

circuit!



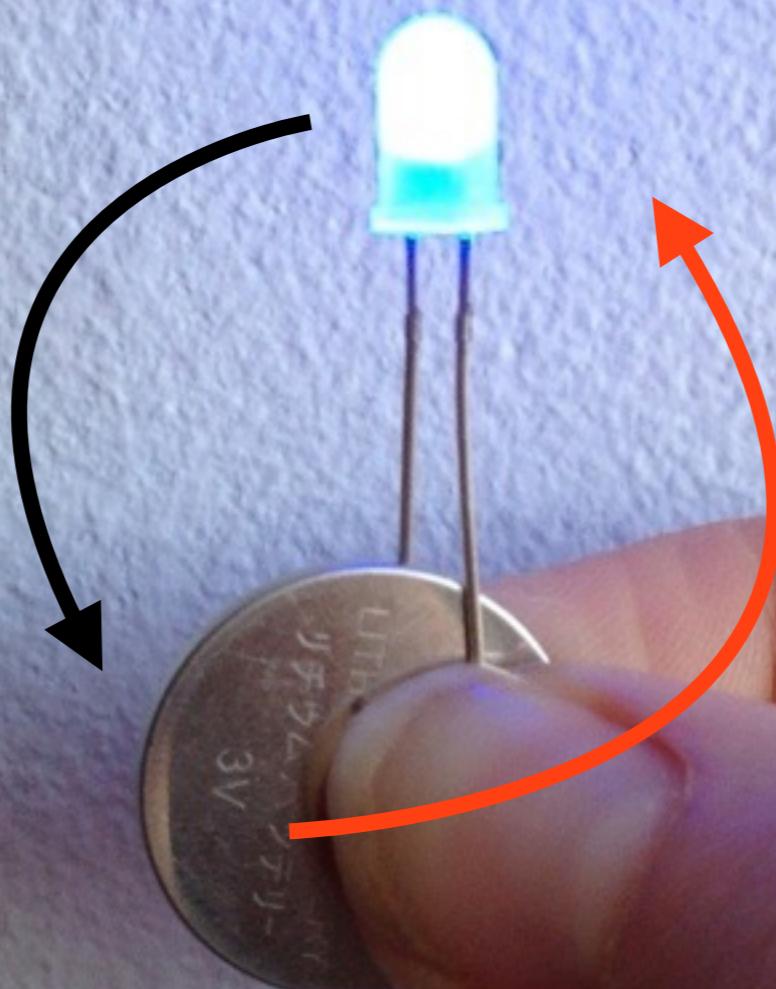
3 volts



eats 1.7
- 2.5
volts

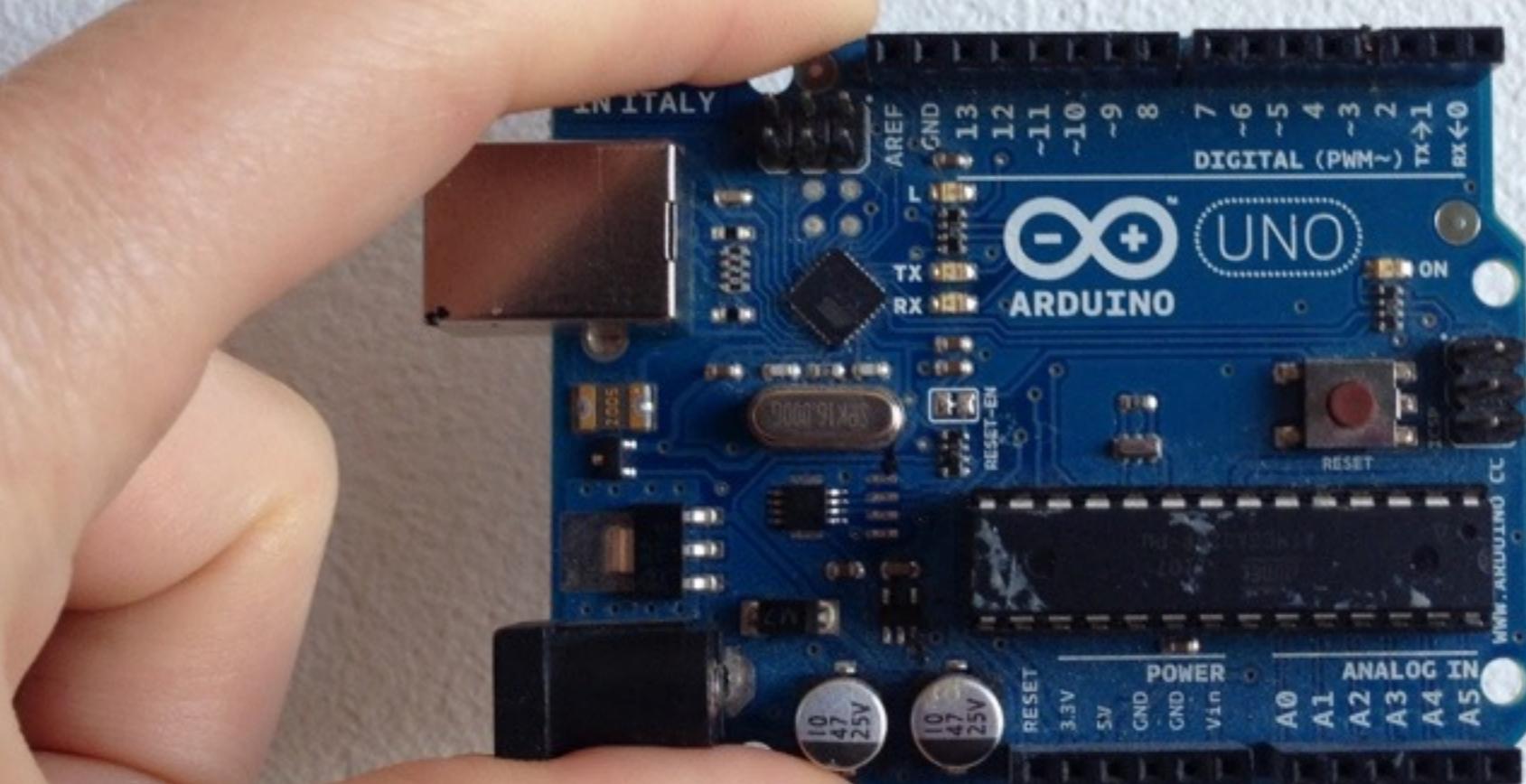
eats 2 volts

1 volt =
a little
heat

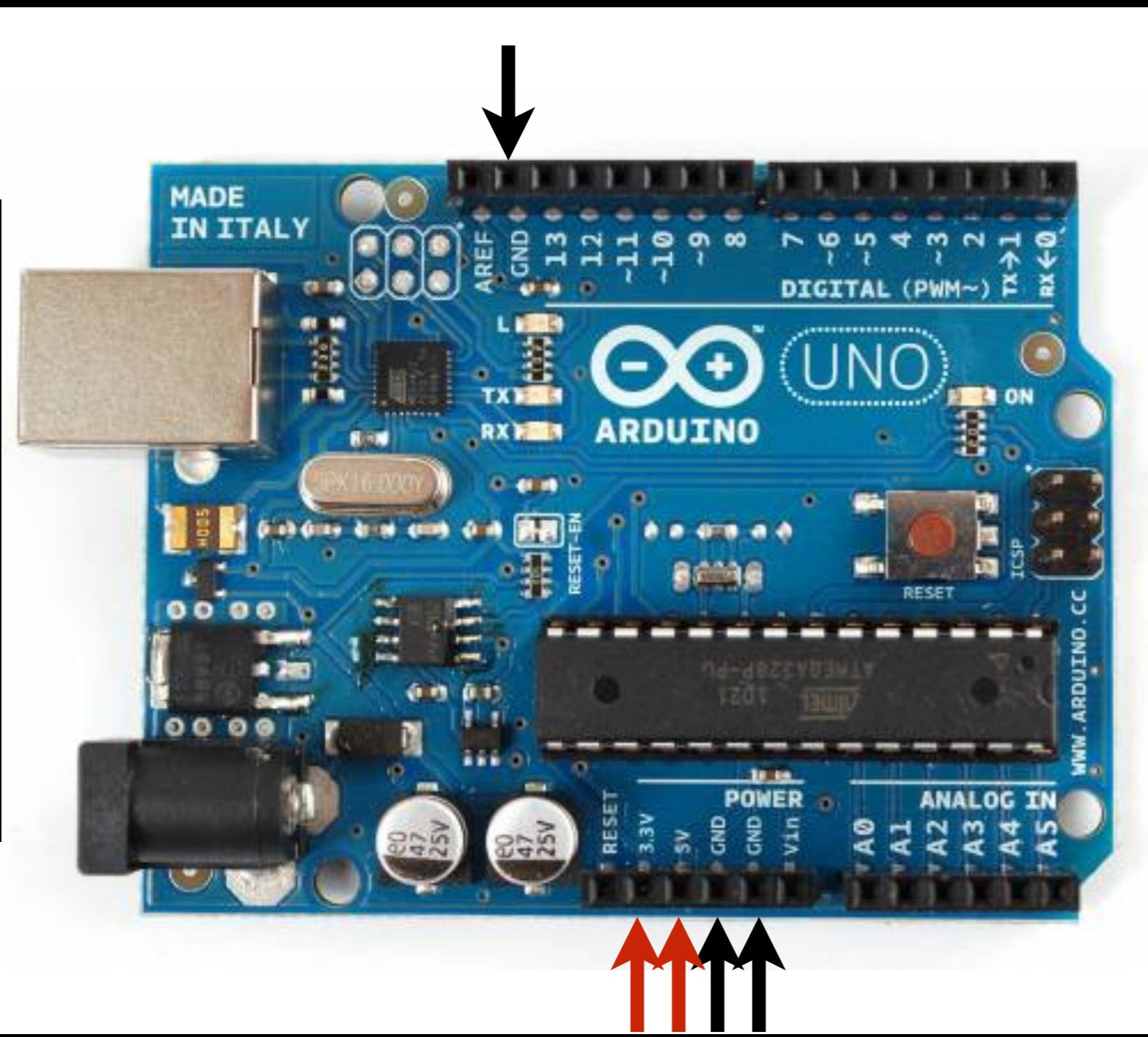


3 volts

getting to know
your new bestie:
arduino, a
microcontroller



a pin provides an input or output through which the controller can communicate with components.



3 ground pins

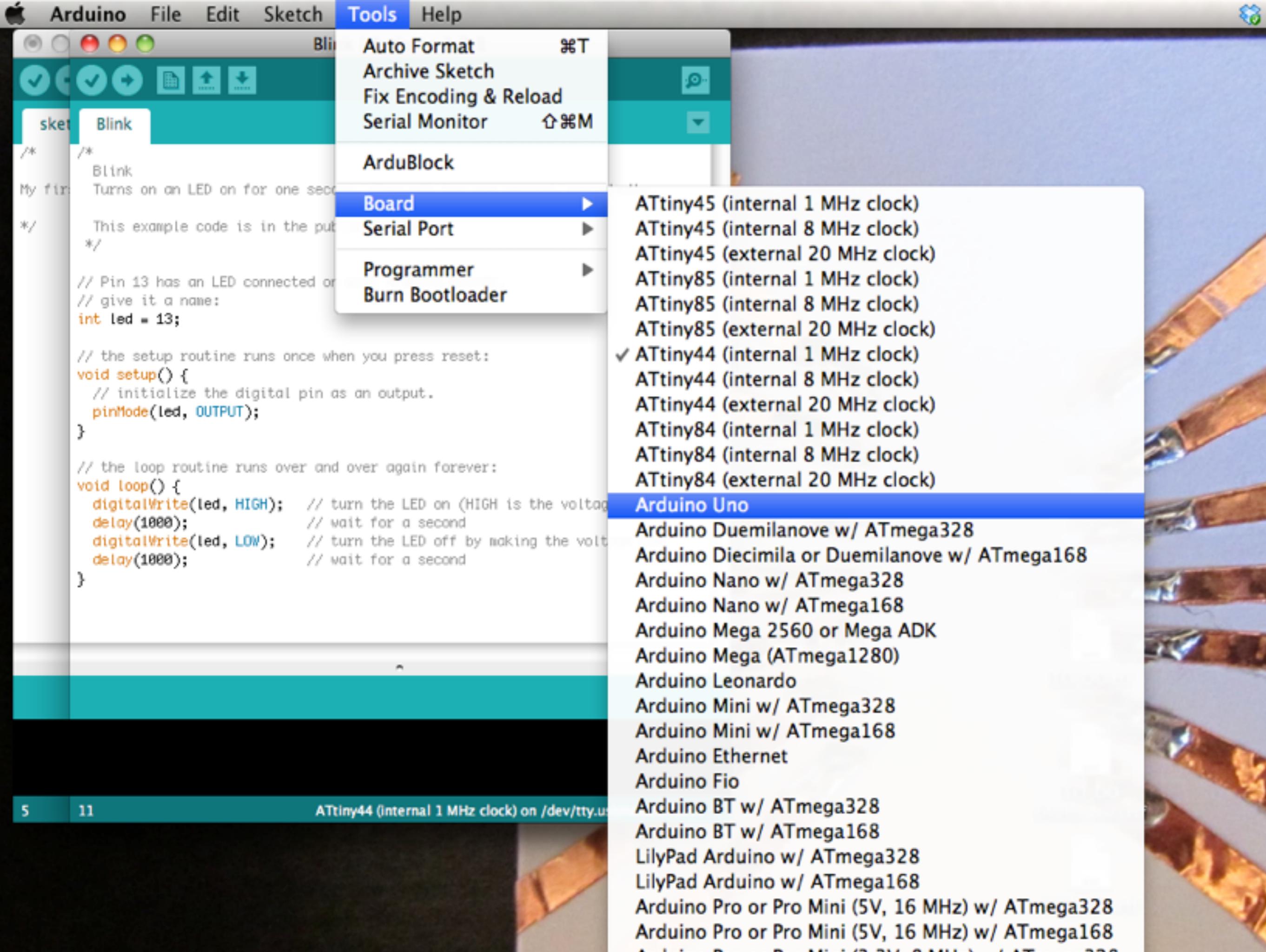
3 power pins

// 5 volts

// 3 volts

let's build!

hello world!



Auto Format ⌘T

Archive Sketch

Fix Encoding & Reload

Serial Monitor ⌘M

ArduBlock

Board ▶

Serial Port ▶

Programmer ▶

Burn Bootloader

ATTiny45 (internal 1 MHz clock)

ATTiny45 (internal 8 MHz clock)

ATTiny45 (external 20 MHz clock)

ATTiny85 (internal 1 MHz clock)

ATTiny85 (internal 8 MHz clock)

ATTiny85 (external 20 MHz clock)

✓ ATTiny44 (internal 1 MHz clock)

ATTiny44 (internal 8 MHz clock)

ATTiny44 (external 20 MHz clock)

ATTiny84 (internal 1 MHz clock)

ATTiny84 (internal 8 MHz clock)

ATTiny84 (external 20 MHz clock)

Arduino Uno

Arduino Duemilanove w/ ATmega328

Arduino Diecimila or Duemilanove w/ ATmega168

Arduino Nano w/ ATmega328

Arduino Nano w/ ATmega168

Arduino Mega 2560 or Mega ADK

Arduino Mega (ATmega1280)

Arduino Leonardo

Arduino Mini w/ ATmega328

Arduino Mini w/ ATmega168

Arduino Ethernet

Arduino Fio

Arduino BT w/ ATmega328

Arduino BT w/ ATmega168

LilyPad Arduino w/ ATmega328

LilyPad Arduino w/ ATmega168

Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328

Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168

Arduino Due Mini (3.3V, 8 MHz) w/ ATmega328

Arduino File Edit Sketch

Tools Help

Auto Format ⌘T
Archive Sketch
Fix Encoding & Reload
Serial Monitor ⌘M

ArduBlock

Board ▶

Serial Port ▶

Programmer ▶

Burn Bootloader

/dev/tty.usbmodemfa141
/dev/cu.usbmodemfa141
/dev/tty.Bluetooth-PDA-Sync
/dev/cu.Bluetooth-PDA-Sync
/dev/tty.Bluetooth-Modem
/dev/cu.Bluetooth-Modem

```
sketchbook/Blink.ino
/*
 * Blink
 * Turns on an LED on for one second,
 * then turns it off for one second,
 * repeatedly.
 */
// This example code is in the public domain.

// Pin 13 has an LED connected or
// give it a name:
int led = 13;

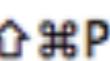
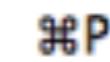
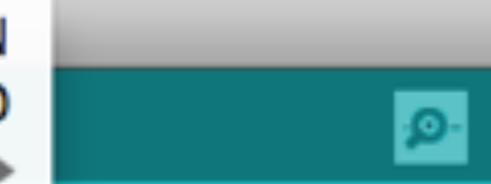
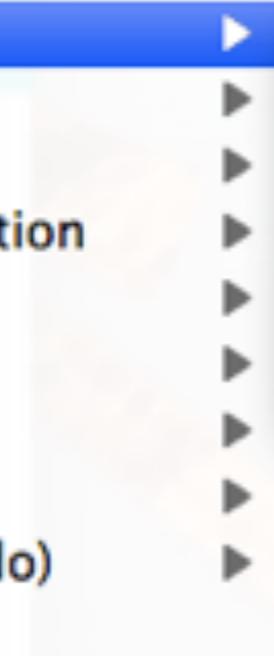
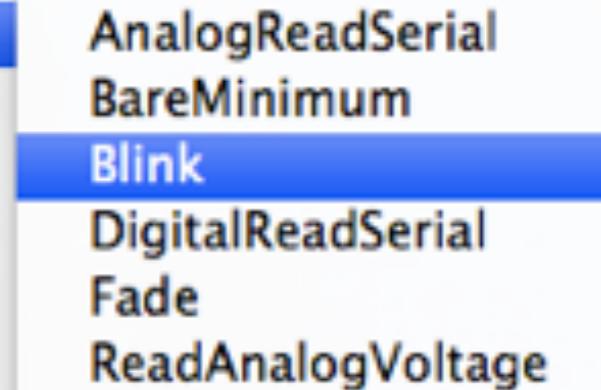
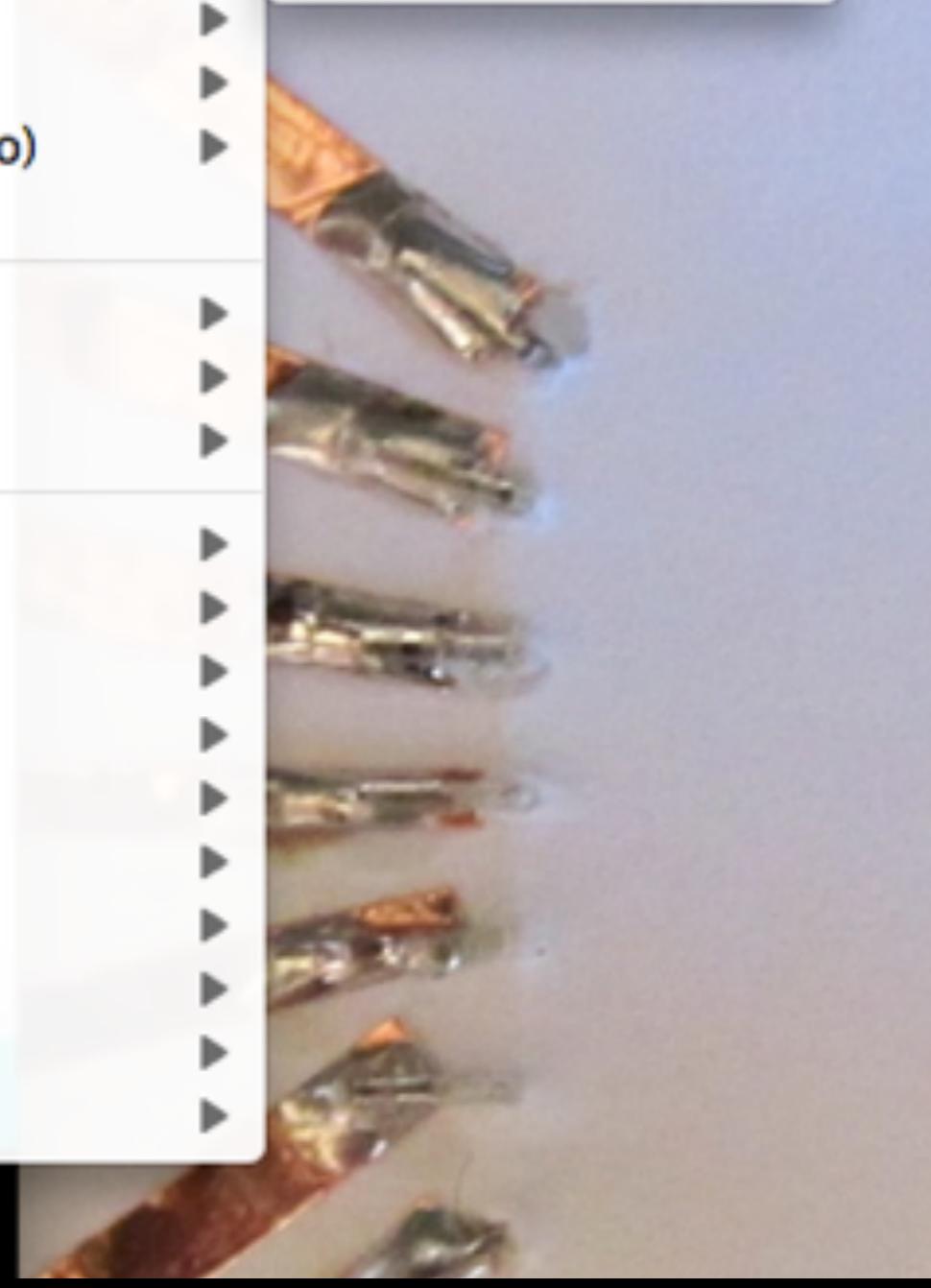
// the setup routine runs once when you press reset:
void setup() {
    // initialize the digital pin as an output.
    pinMode(led, OUTPUT);
}

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

New
Open...
Sketchbook

sketch_oct07

Examples

Close
Save
Save As...
Upload
Upload Using ProgrammerPage Setup
Print⌘N
⌘O
▶01.Basics
02.Digital
03.Analog
04.Communication
05.Control
06.Sensors
07.Display
08.Strings
09.USB(Leonardo)
ArduinoISPIRremote
LPD8806
PCMEEPROM
Ethernet
Firmata
LiquidCrystal
SD
Servo
SoftwareSerial
SPI
Stepper
WireAnalogReadSerial
BareMinimum
Blink
DigitalReadSerial
Fade
ReadAnalogVoltage



Blink §



```
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/

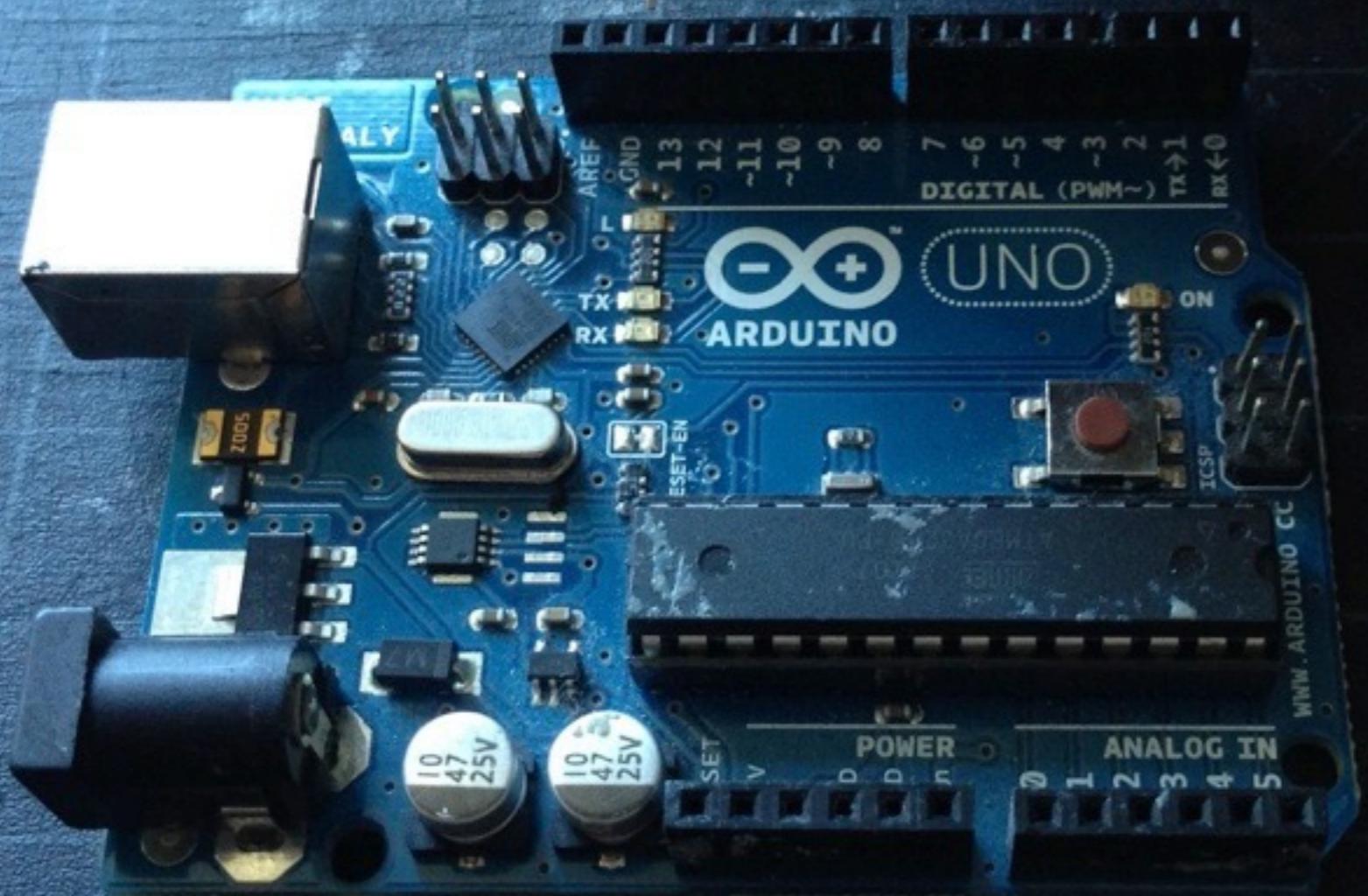
// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

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

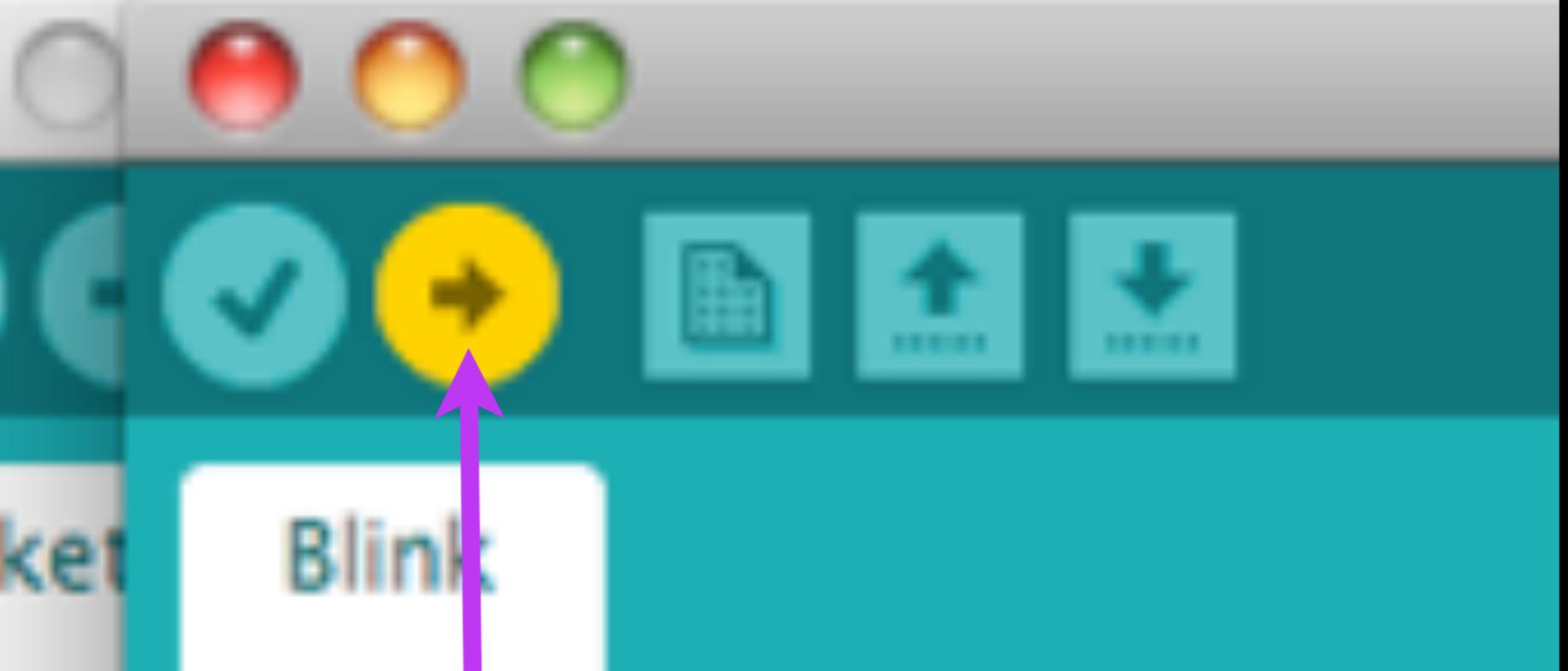
- /GRD

+ /PIN 13



YOU CAN ONLY DO THIS ON PIN 13!

Arduino File Edit Sketch



```
/*
 * Blink
 * Turns on an LED on for one second,
 * then turns it off for one second,
 * repeatedly.
 *
 * This example code is in the public domain.
 */
// Pin 13 has an LED connected
```

Blink 5

```
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/

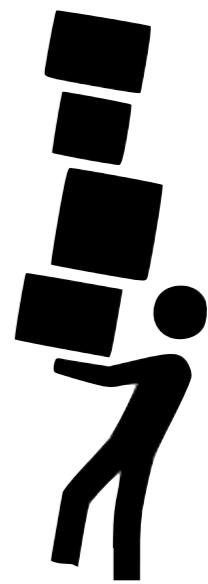
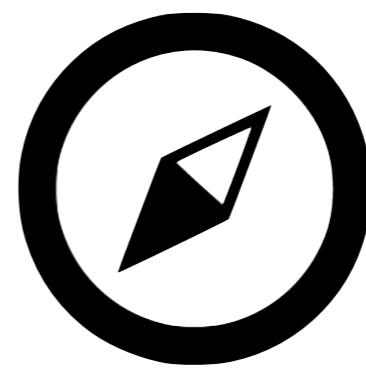
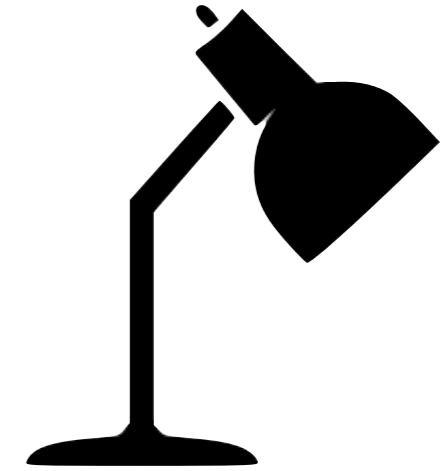
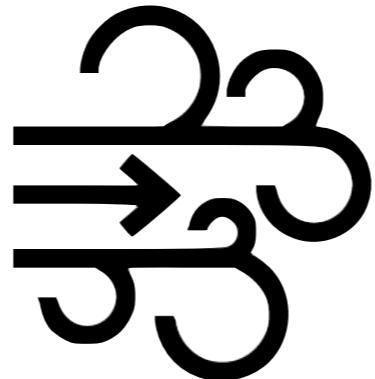
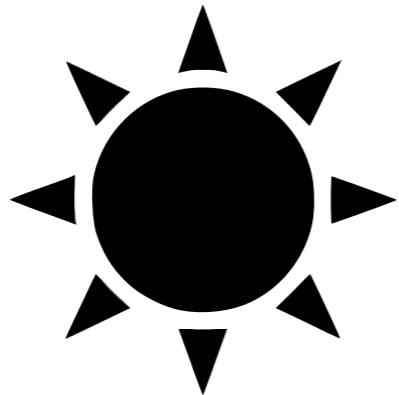
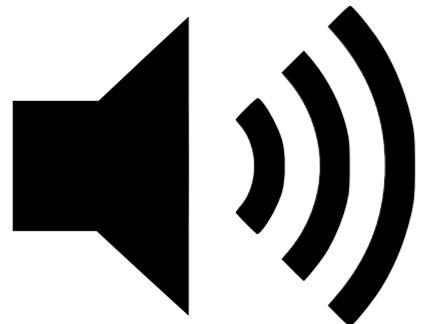
// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
    // initialize the digital pin as an output.
    pinMode(led, OUTPUT);
}

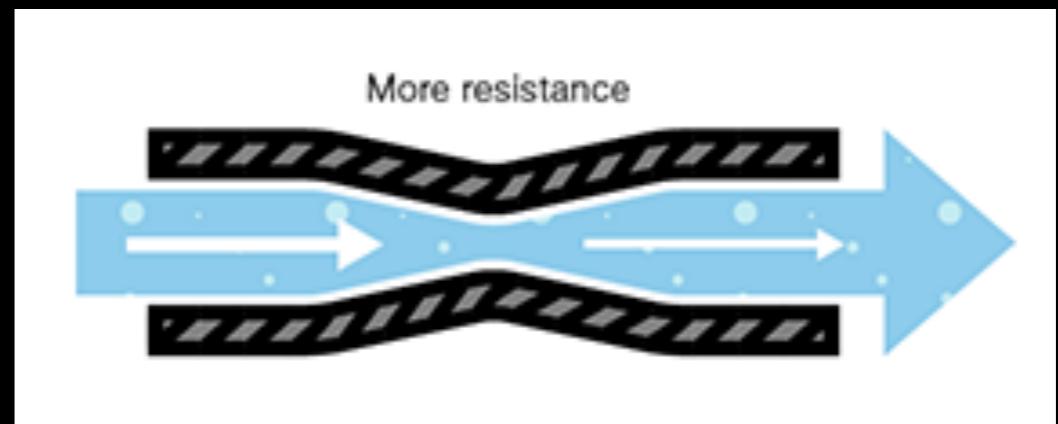
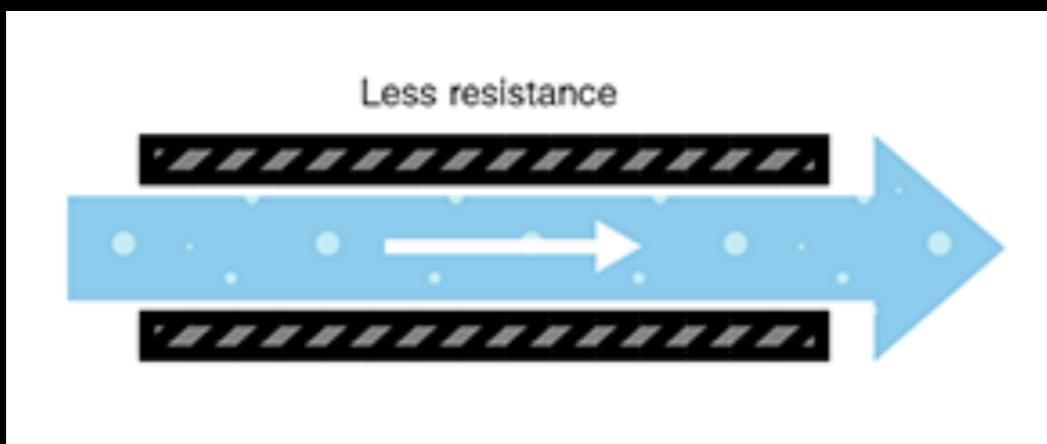
// the loop routine runs over and over again forever:
void loop() {
    digitalWrite(led, HIGH);      // turn the LED on (HIGH is the voltage level)
    delay(1000);                // wait for a second
    digitalWrite(led, LOW);       // turn the LED off by making the voltage LOW
    delay(1000);  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

Try changing these numbers. What happens?

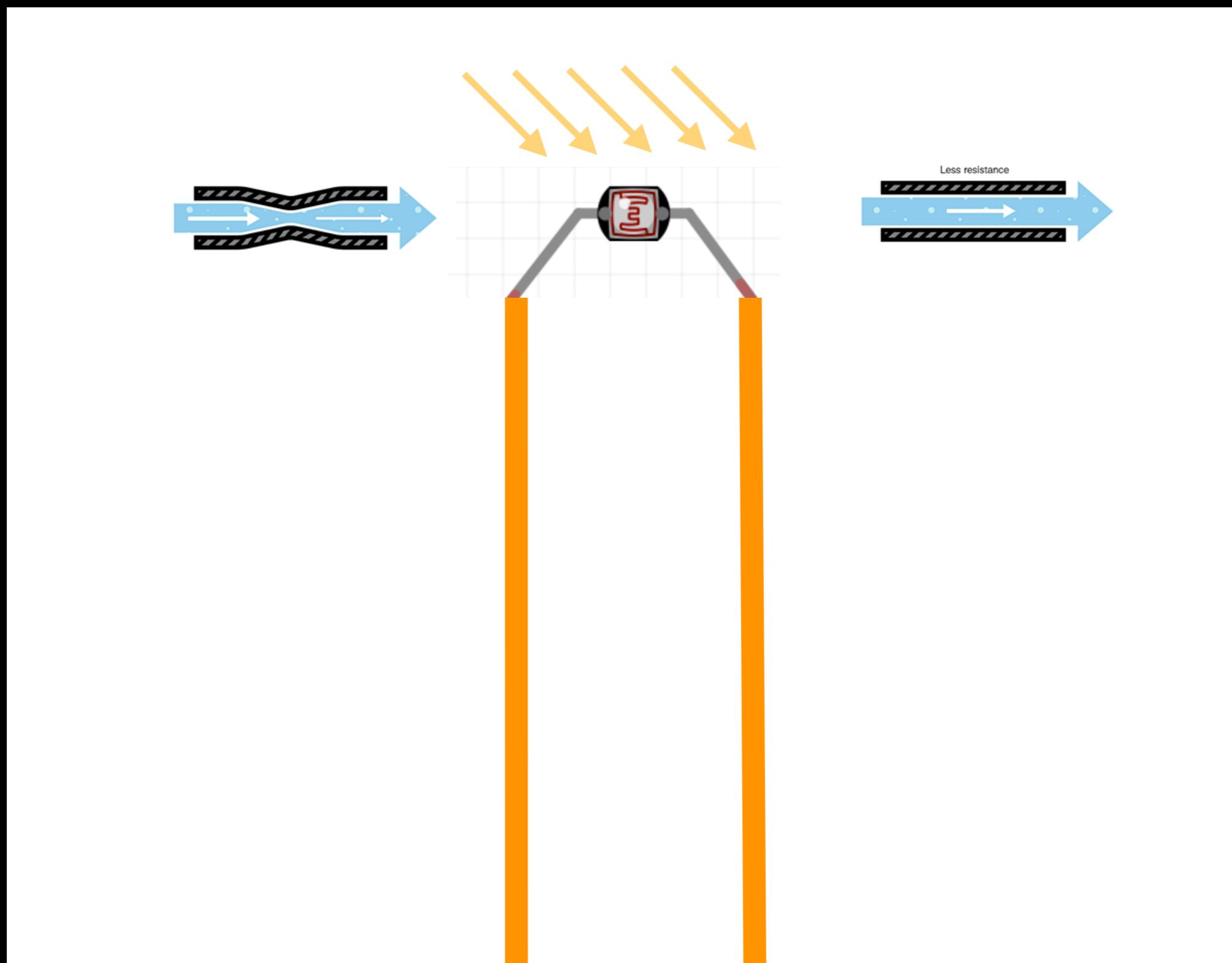
the *really* cool
thing about this:
we can make the
arduino **sense**



resistance is a material's tendency to resist the flow of charge (current) .



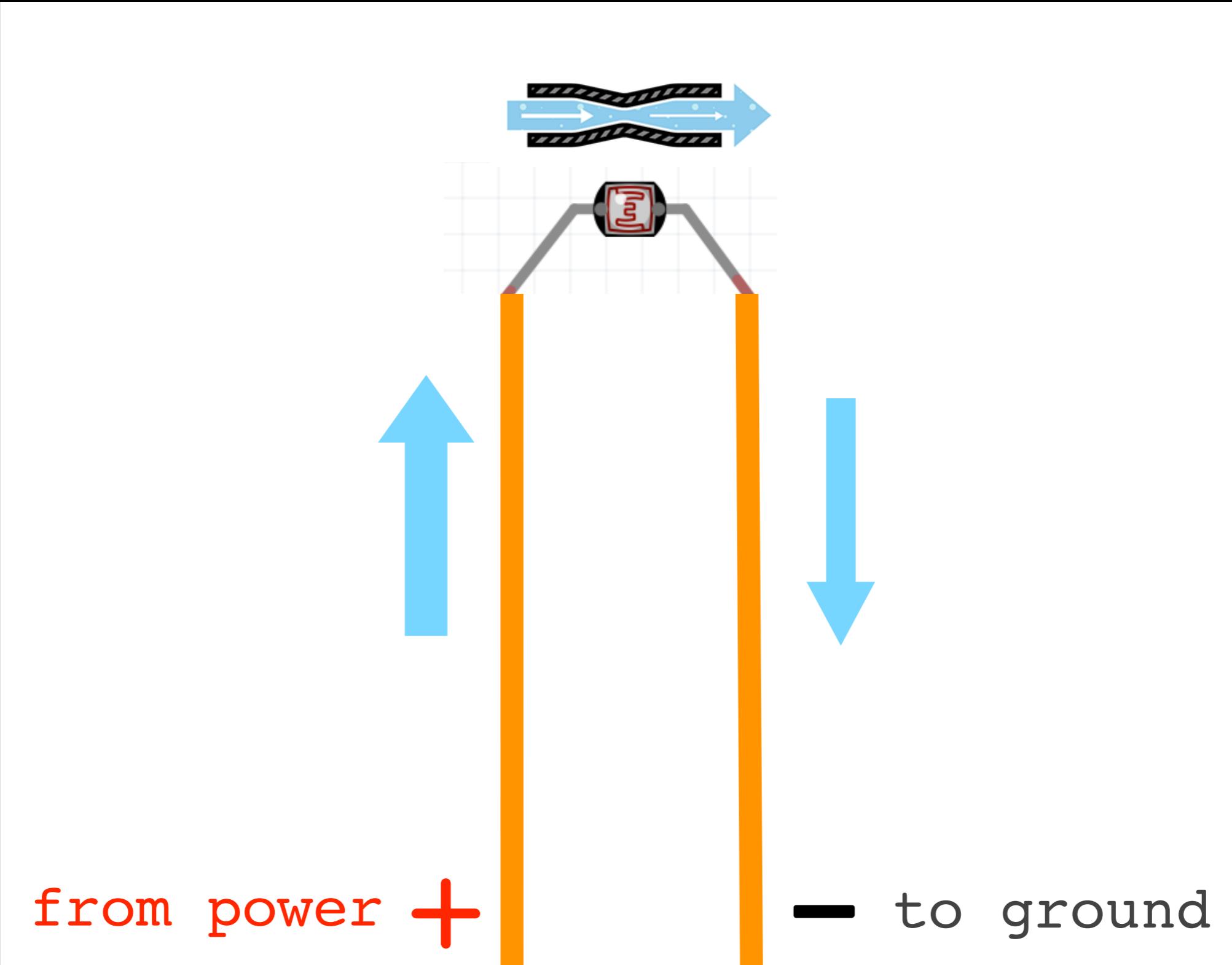


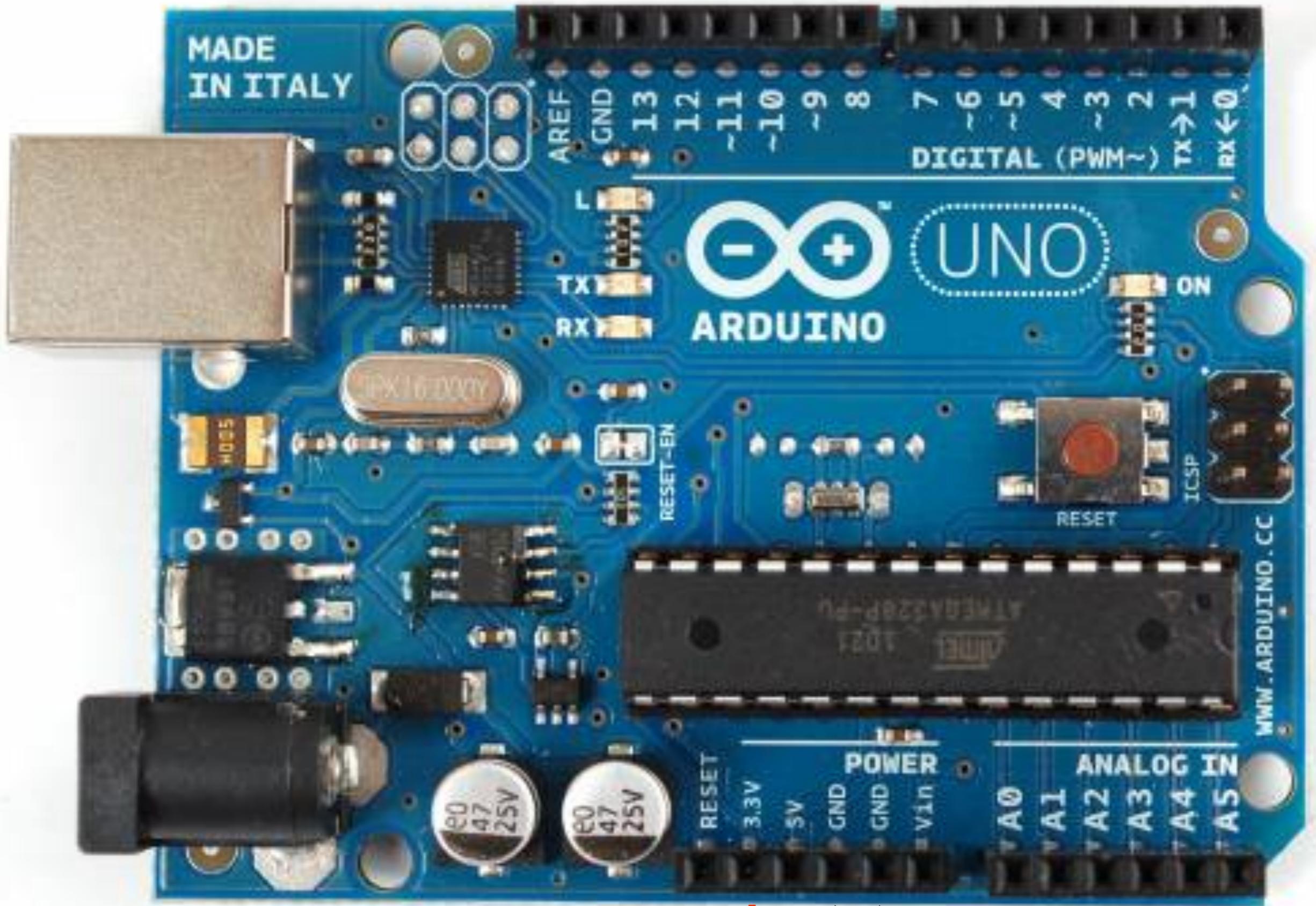




from power +

- to ground





+ power - ground

MADE
IN ITALY

AREF

GND

13

12

11

10

9

8

7

6

5

4

3

2

1

TX → 0

DIGITAL (PWM~) TX → 1

RX ← 0

RX ← 1

13

12

11

10

9

8

7

6

5

4

3

2

1

TX → 0

DIGITAL (PWM~) TX → 1

RX ← 0

RX ← 1



UNO

ARDUINO

RESET

RESET-BN

RESET

ON

ICSP

WWW.ARDUINO.CC

RESET

3.3V

5V

POWER

GND

GND

Vin

A0

ANALOG IN

A1

ANALOG IN

A2

ANALOG IN

A3

ANALOG IN

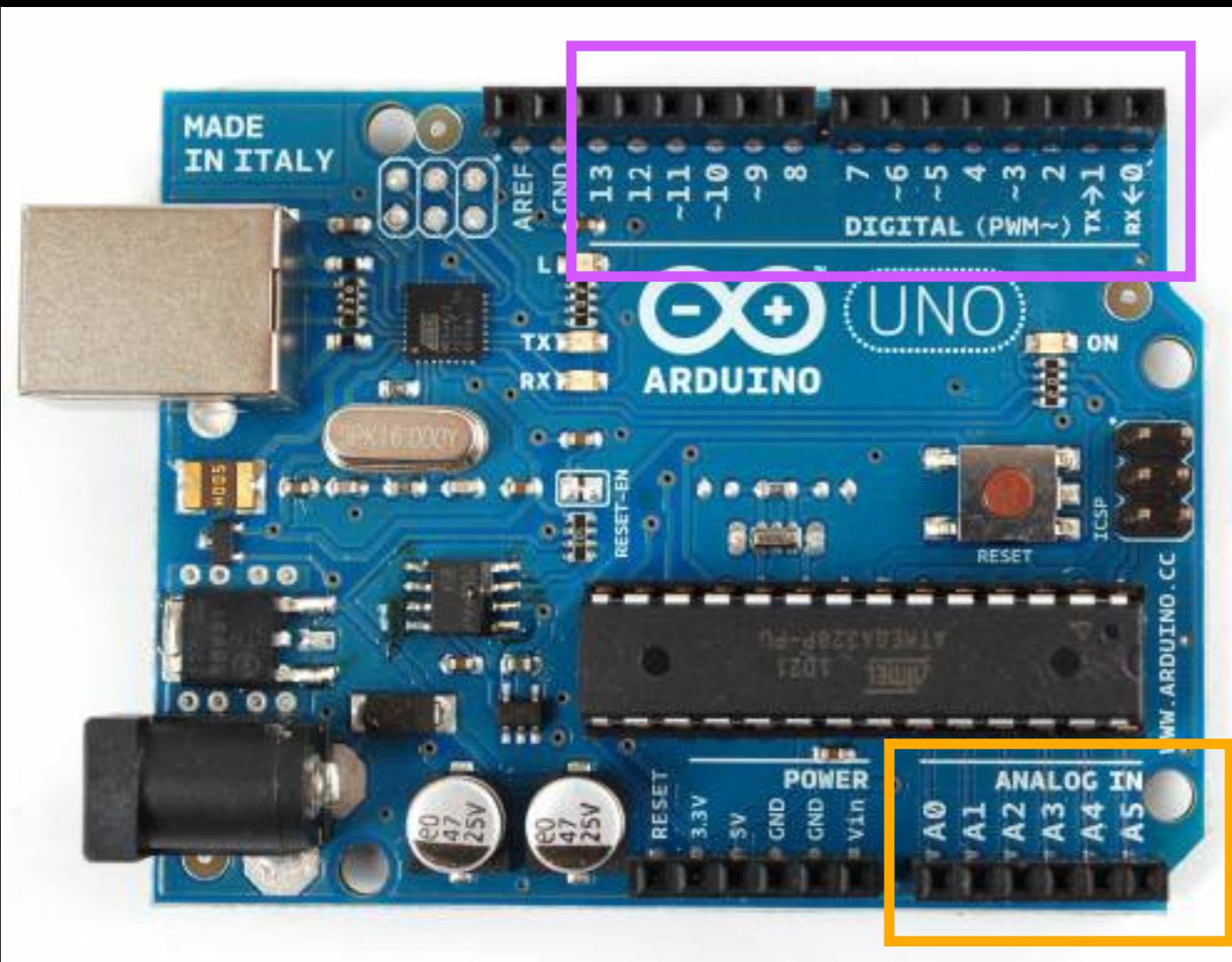
A4

ANALOG IN

A5

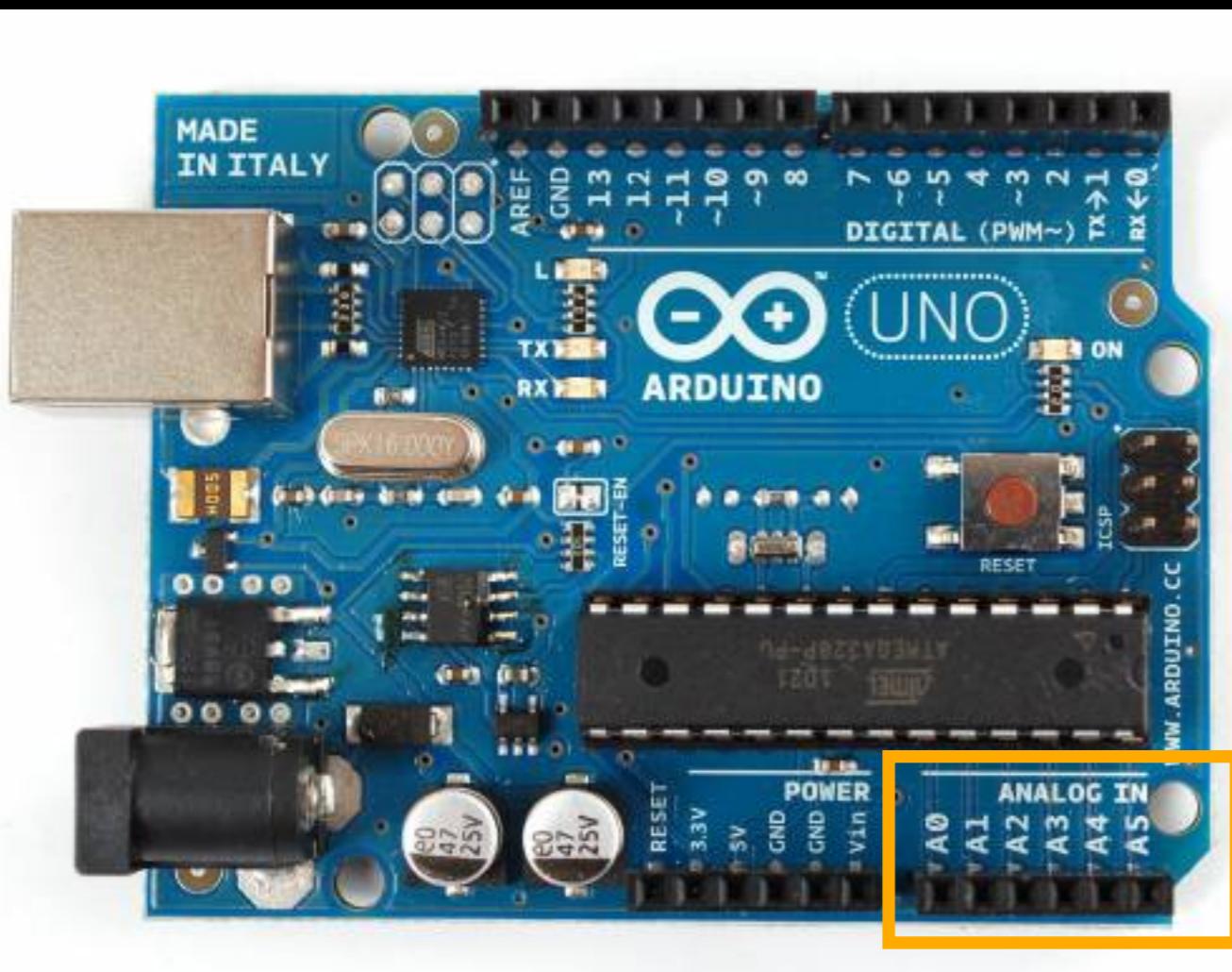
ANALOG IN

a **pin** provides an input or output through which the controller can communicate with components.



14 Digital pins
(input or output)

6 Analog pins
(input only)

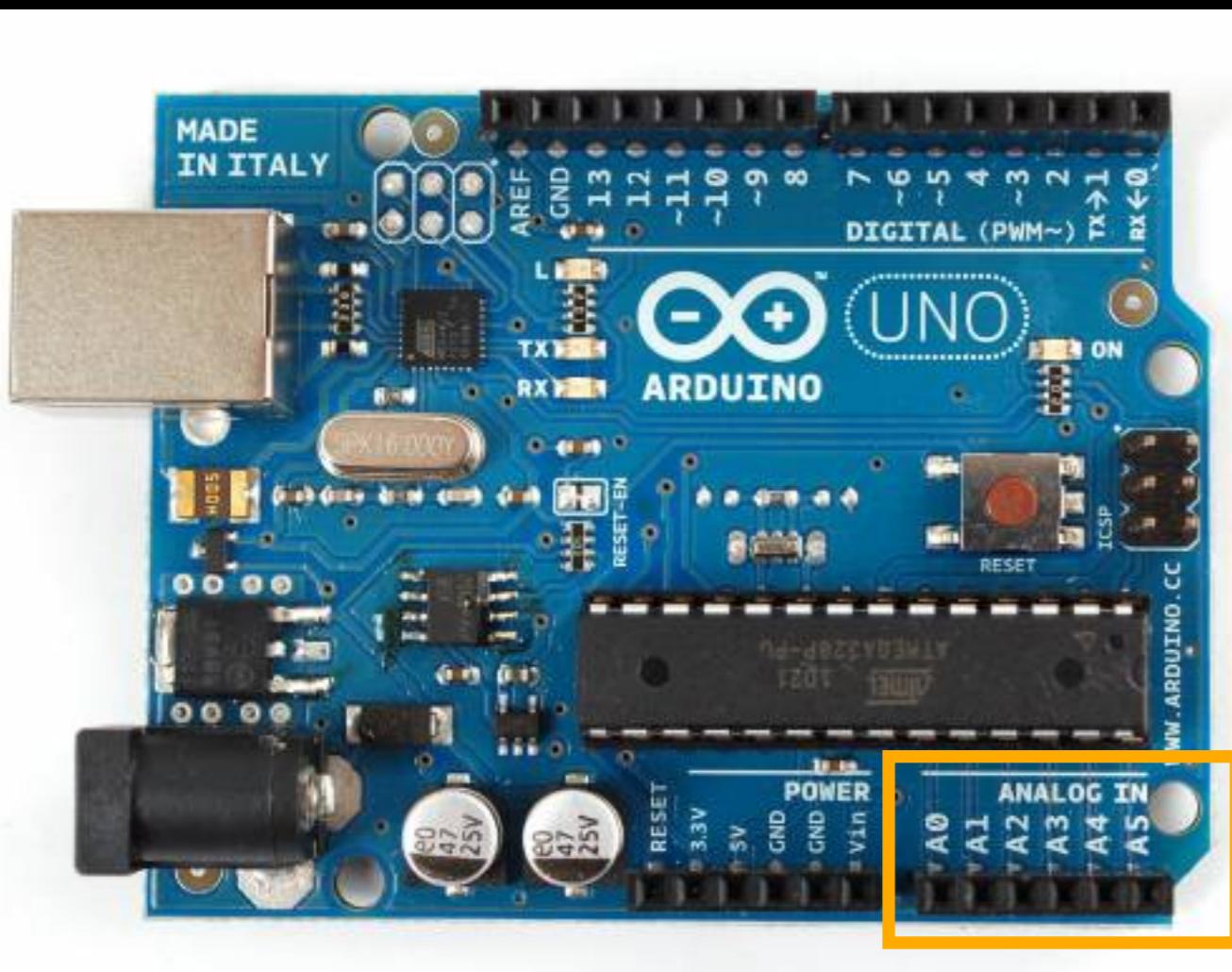


6 Analog Input pins

You can read a wide range of values

Read

0 - 1023



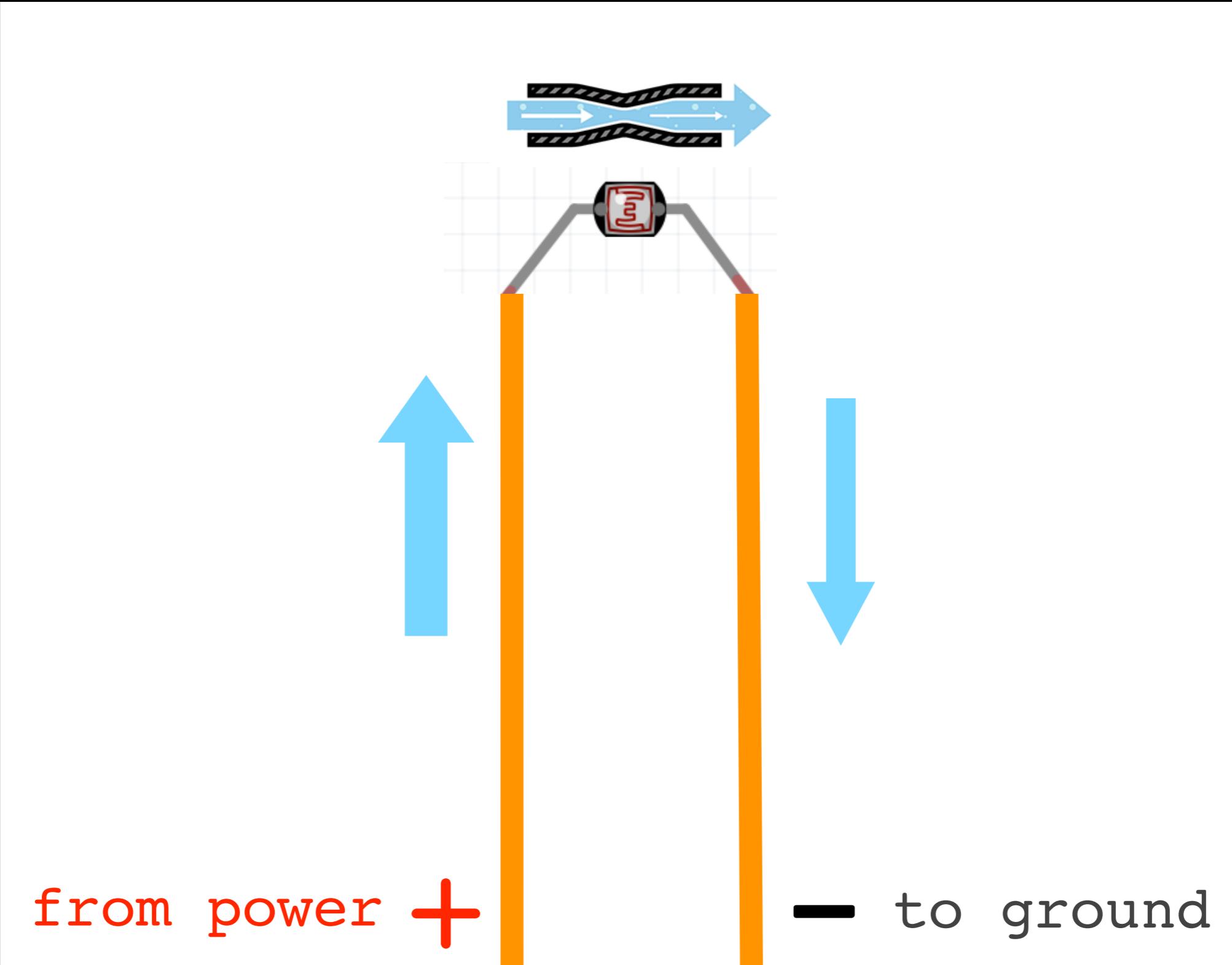
6 Analog Input pins

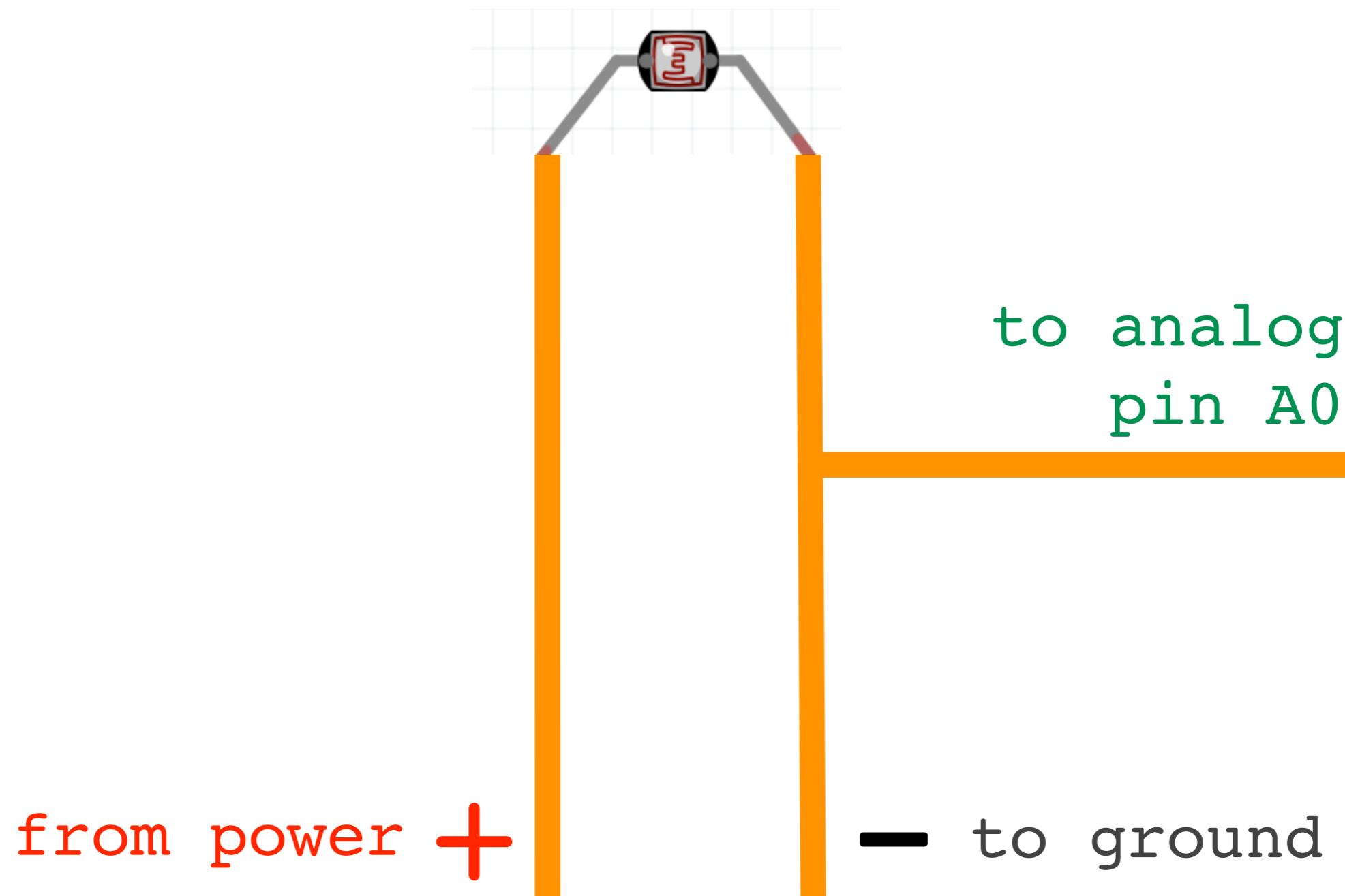
You can read a wide range of values

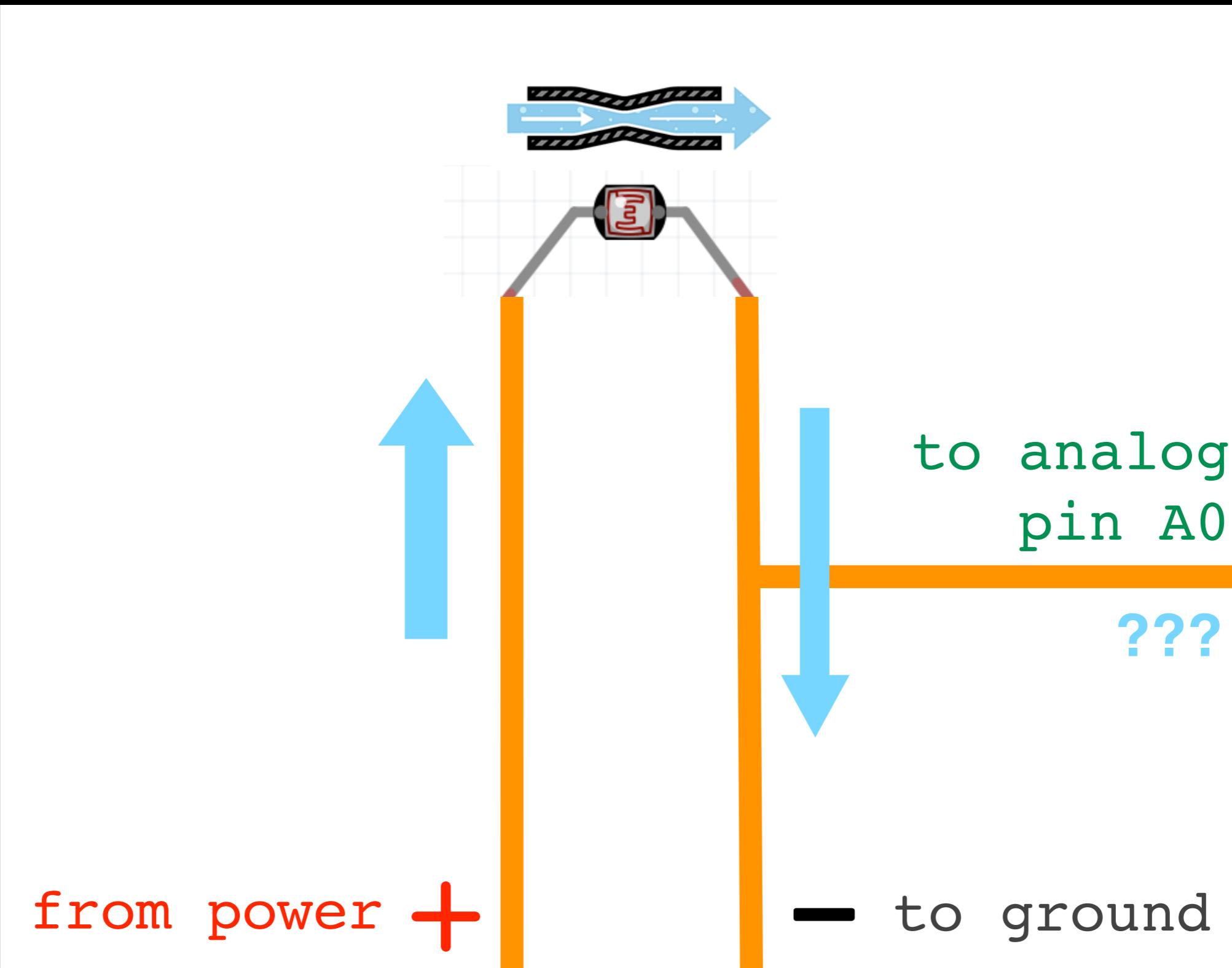
Read 0 - 1023

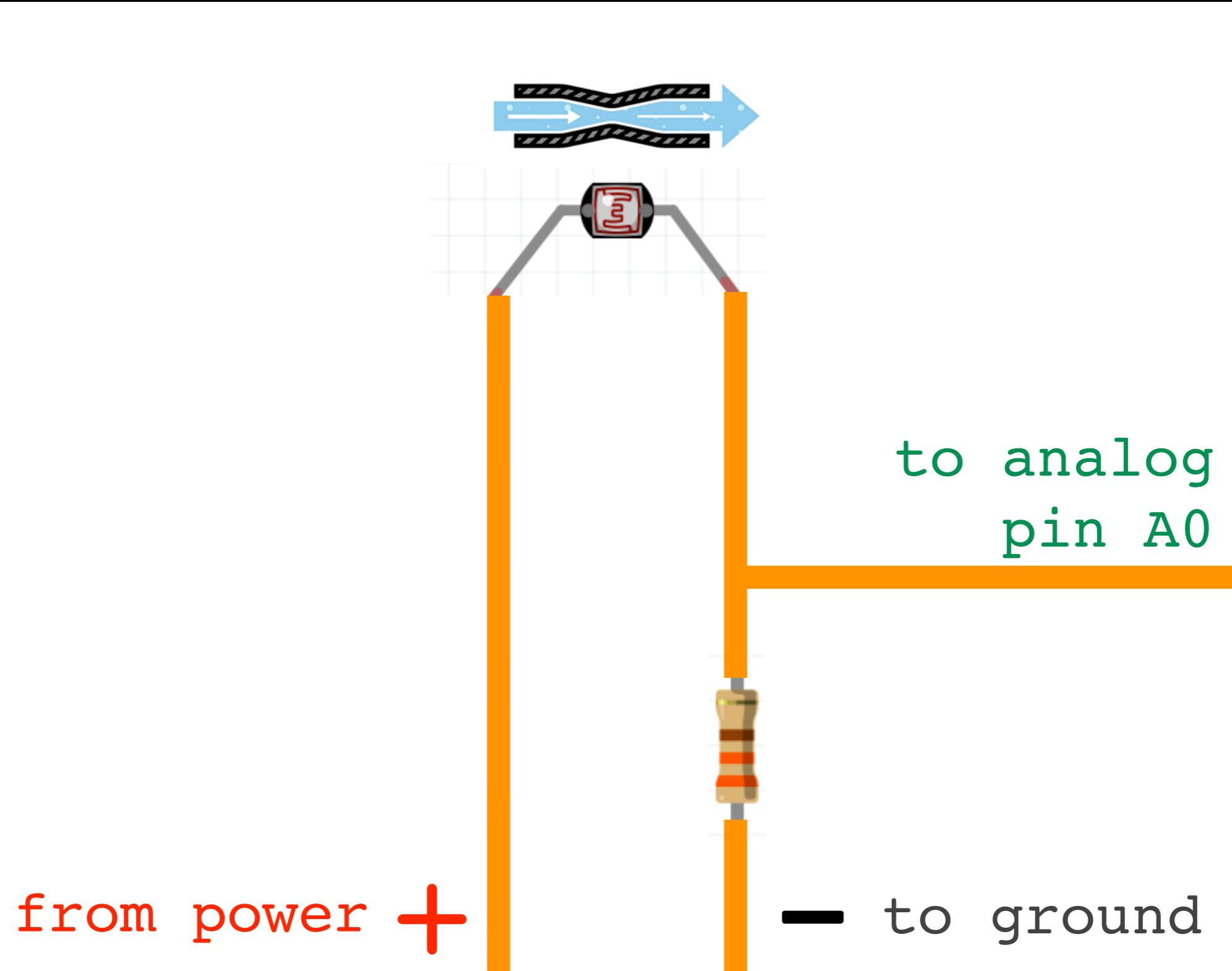
These allow you to turn current into numbers!

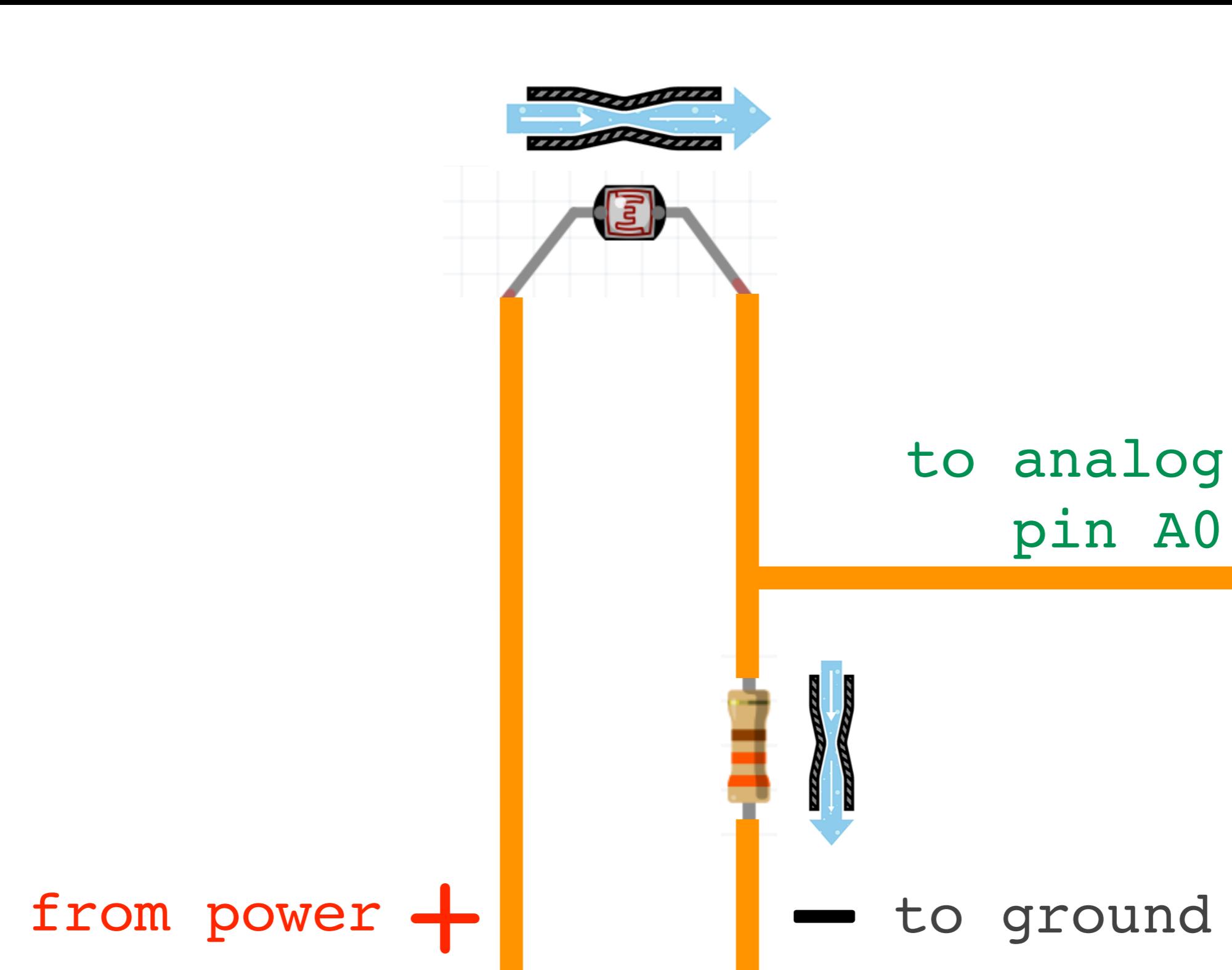
You can use numbers in your computer program.

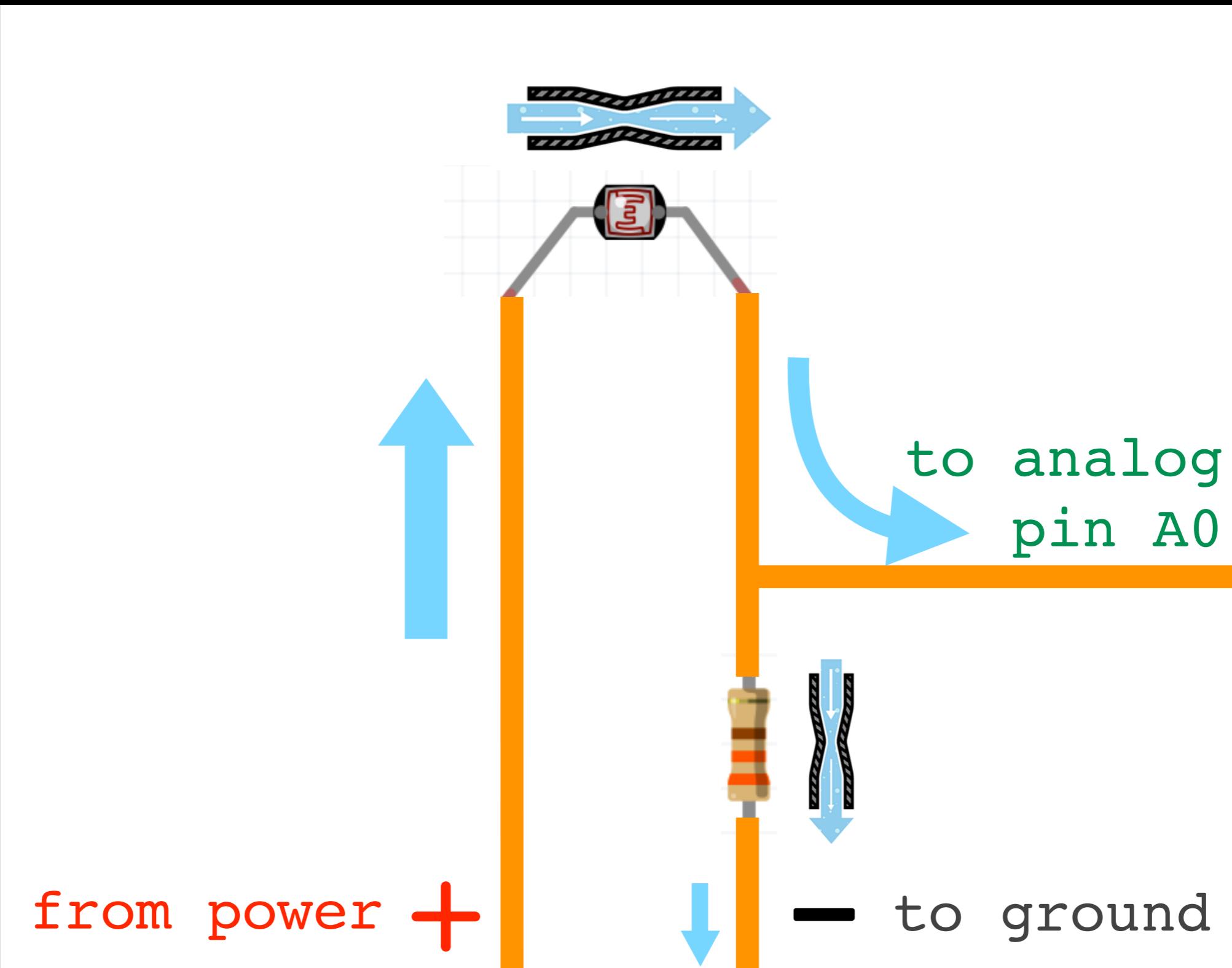




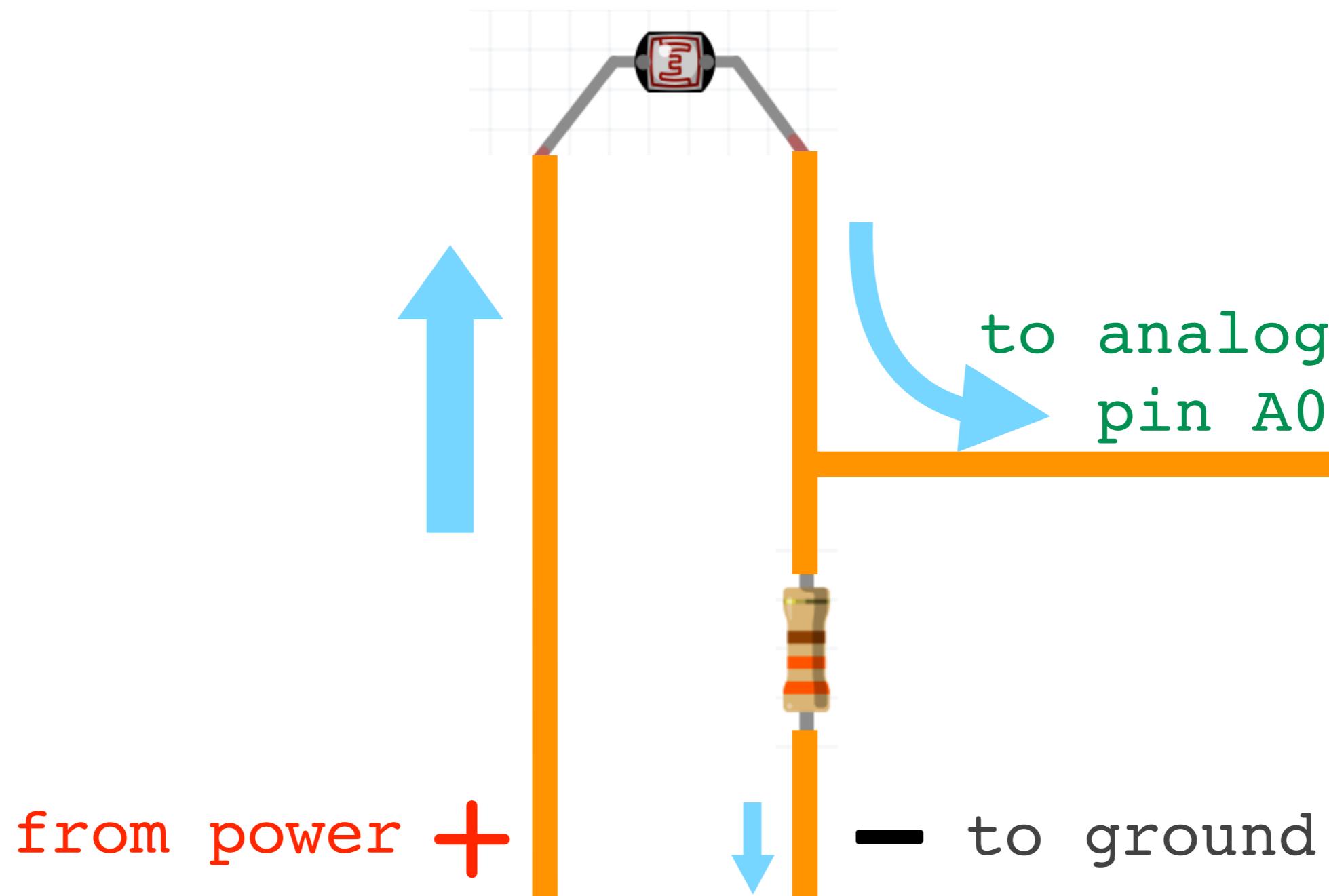




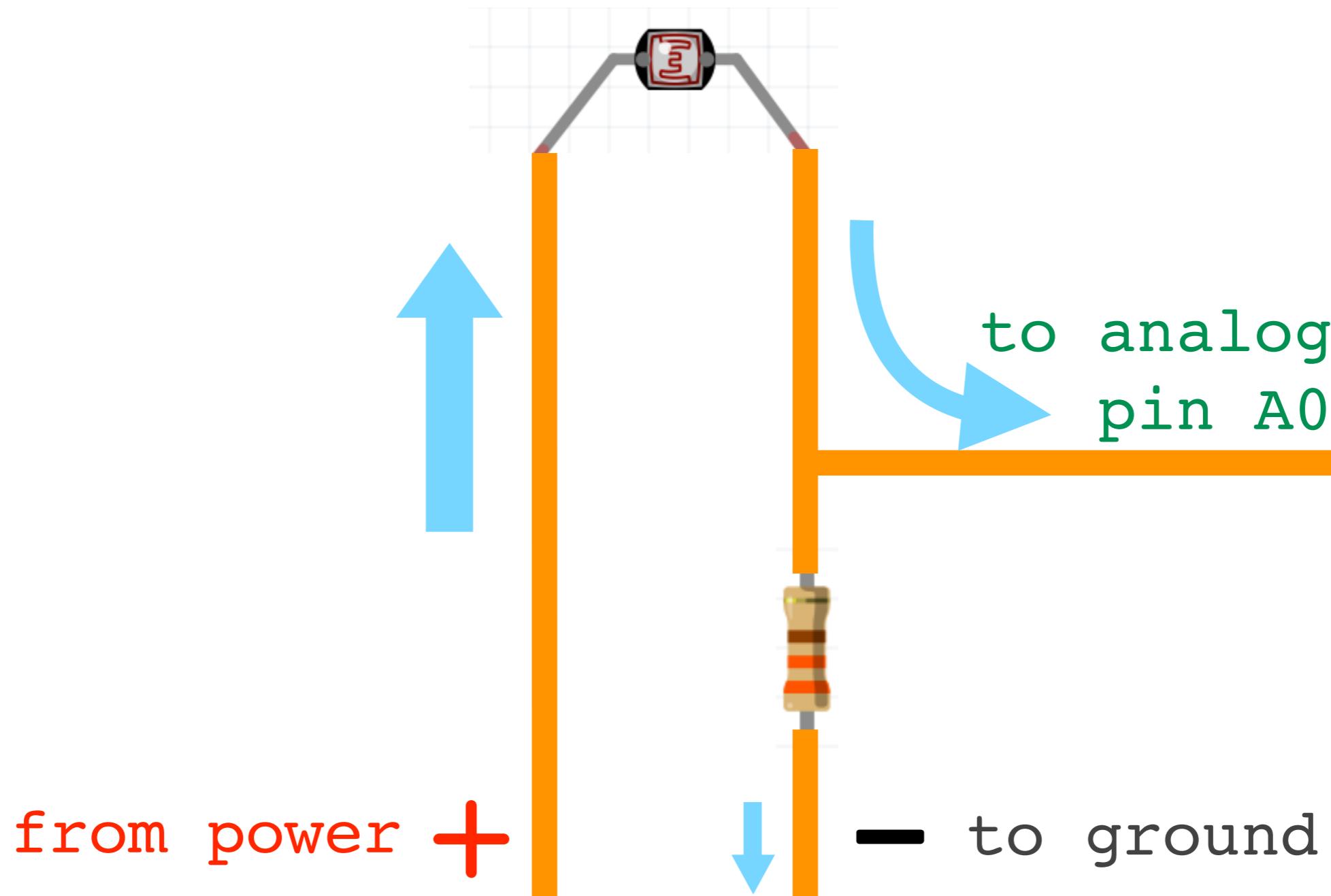


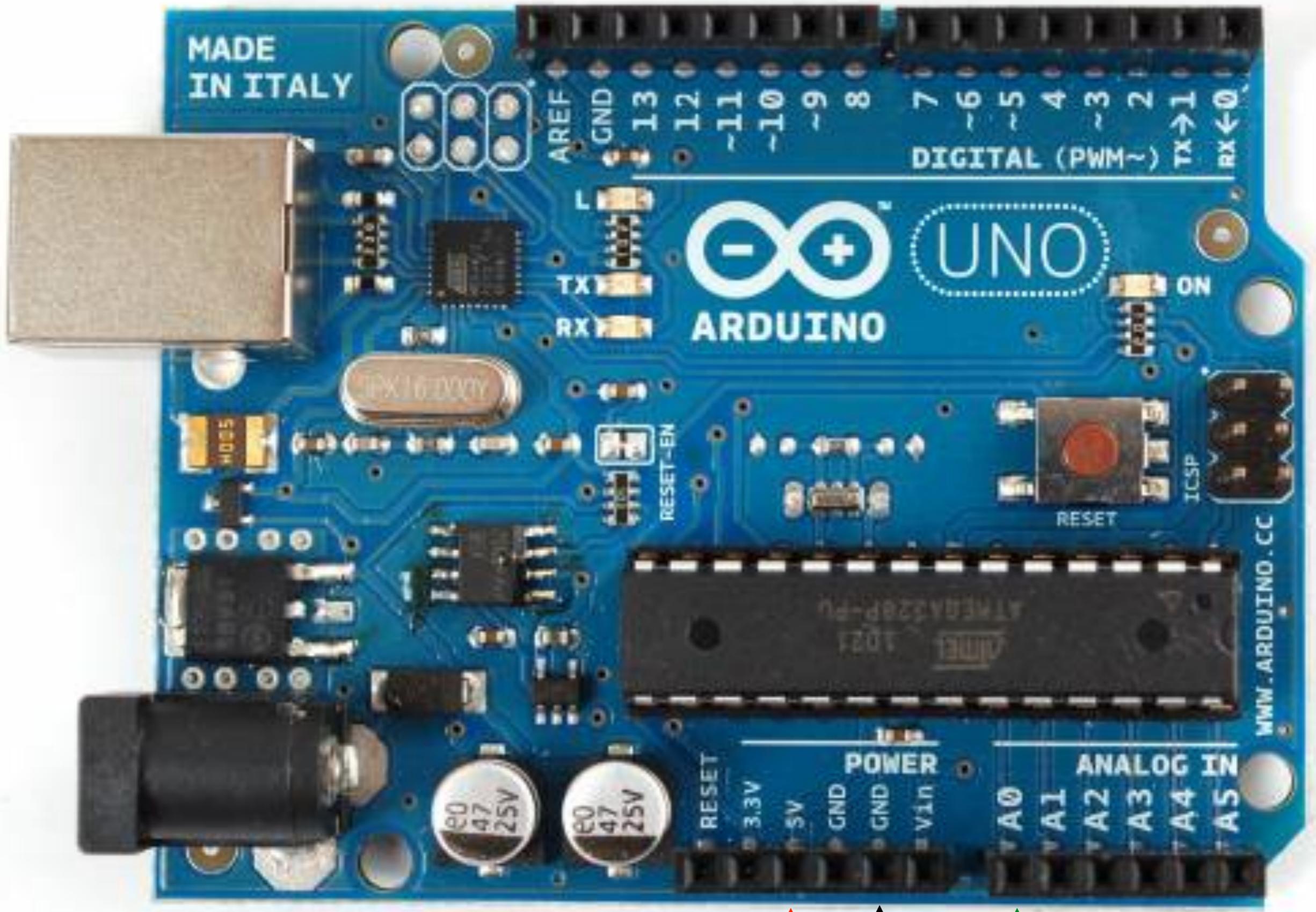


My Light Sensor



My Light Temperature Sensor



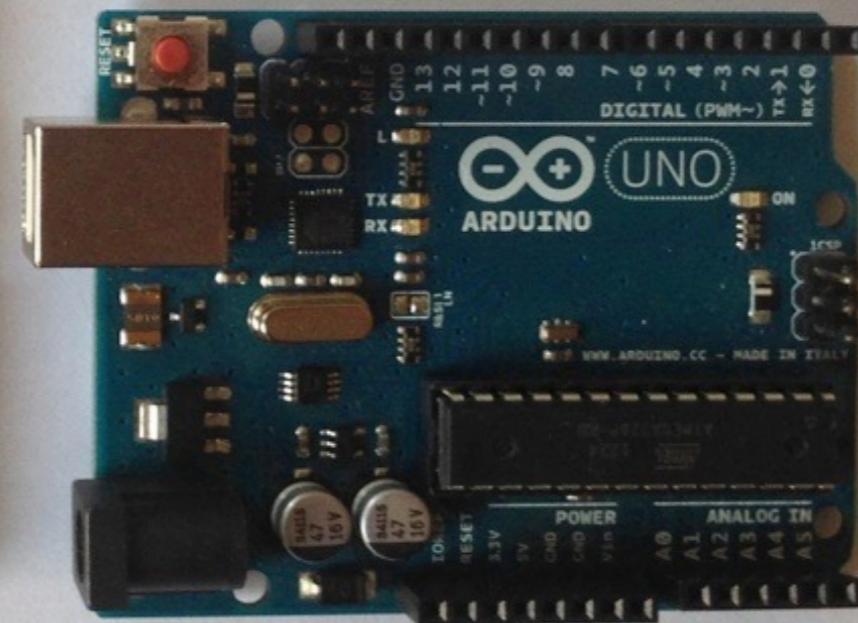
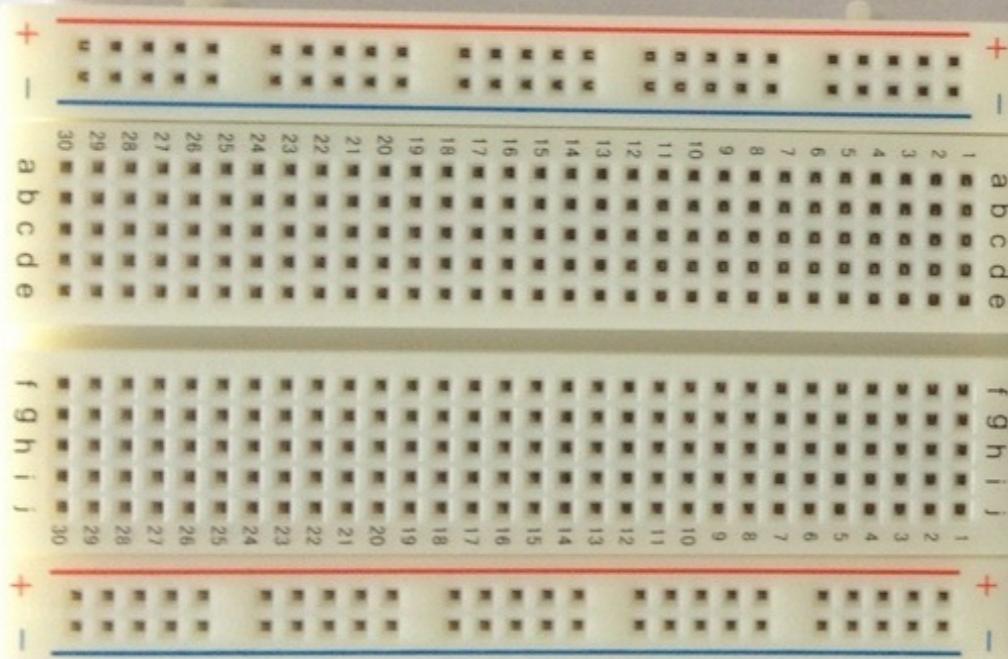


what supplies do
we need?

thermistor

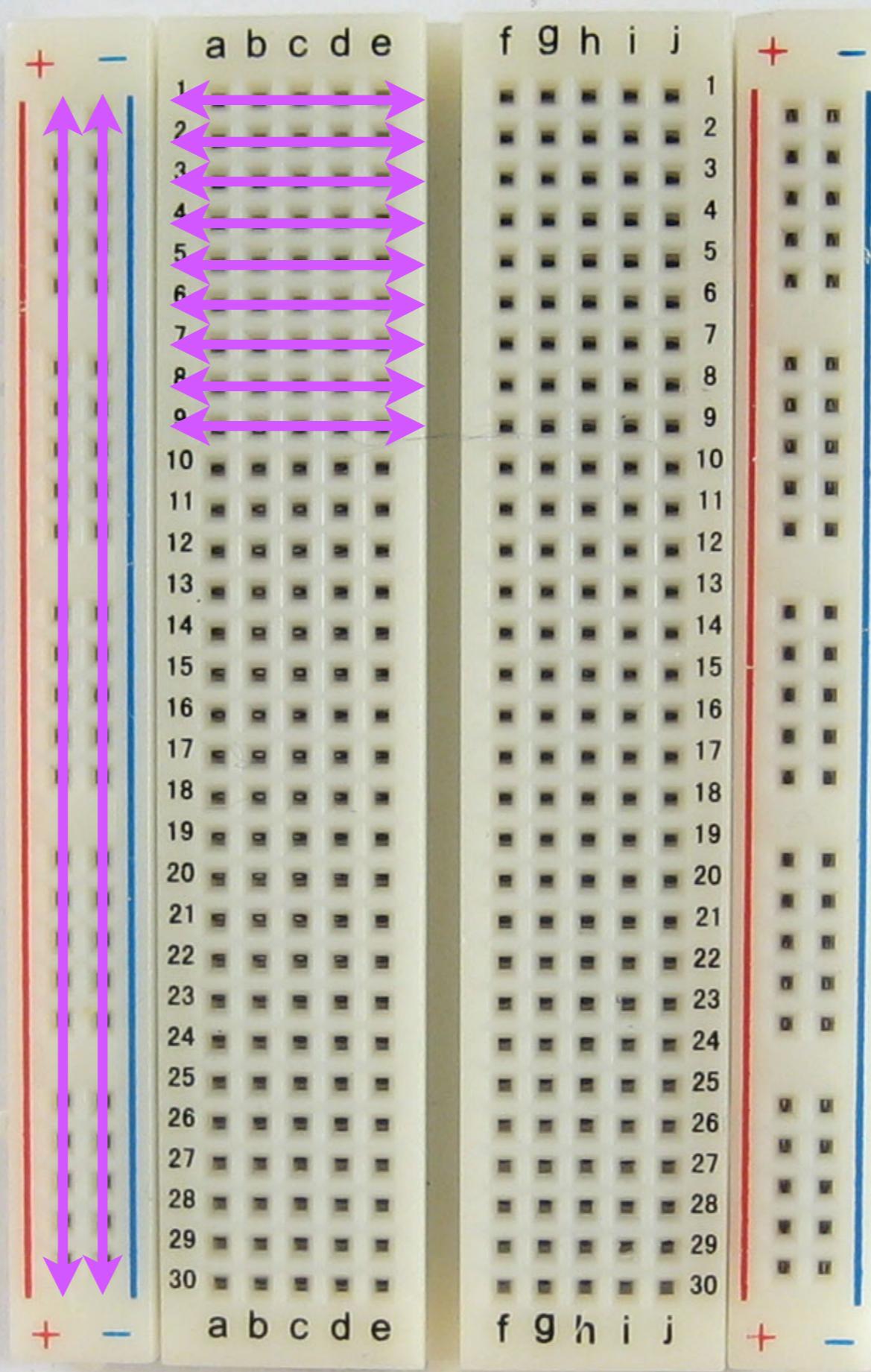
LED

10k ohm
resistor



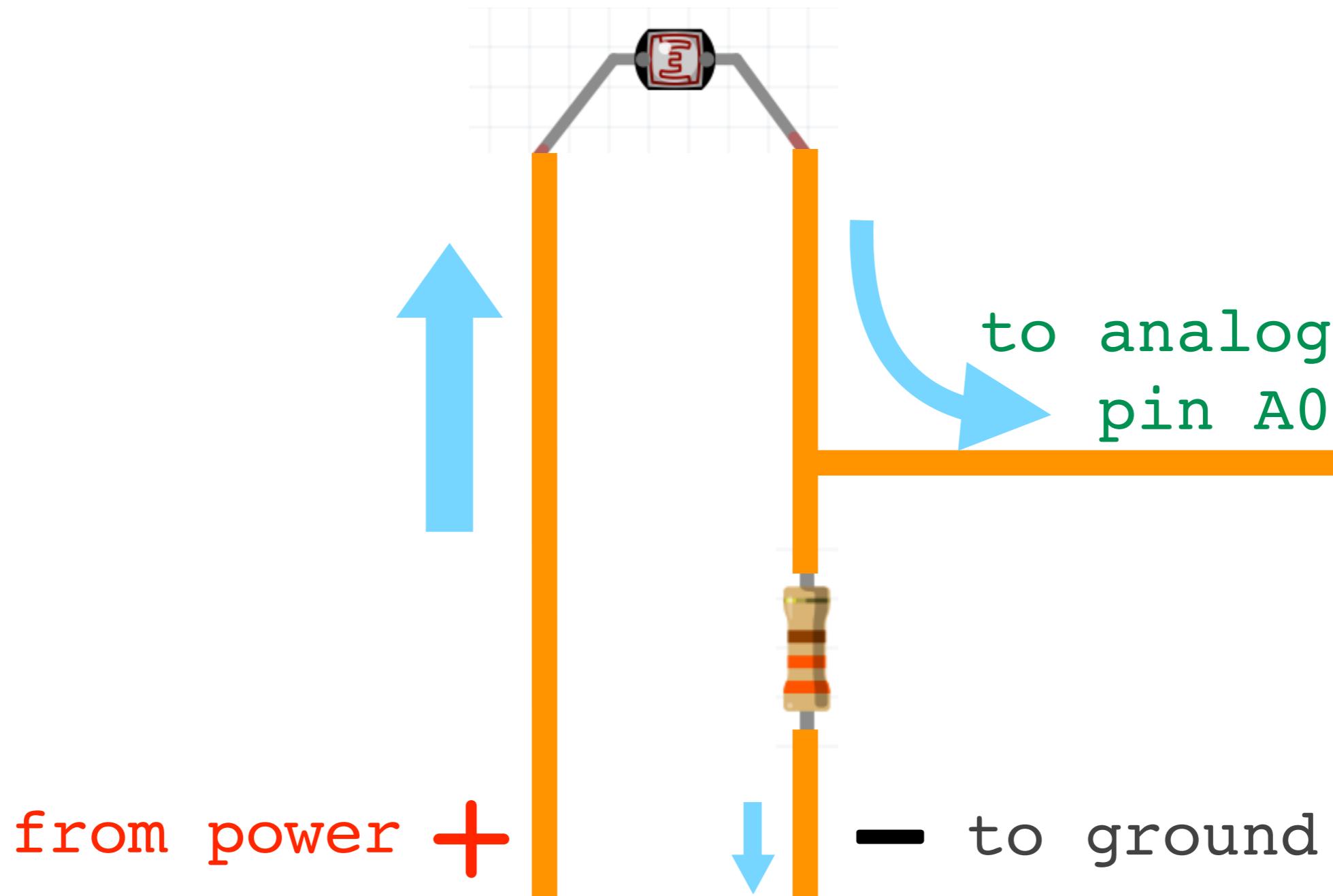
breadboard

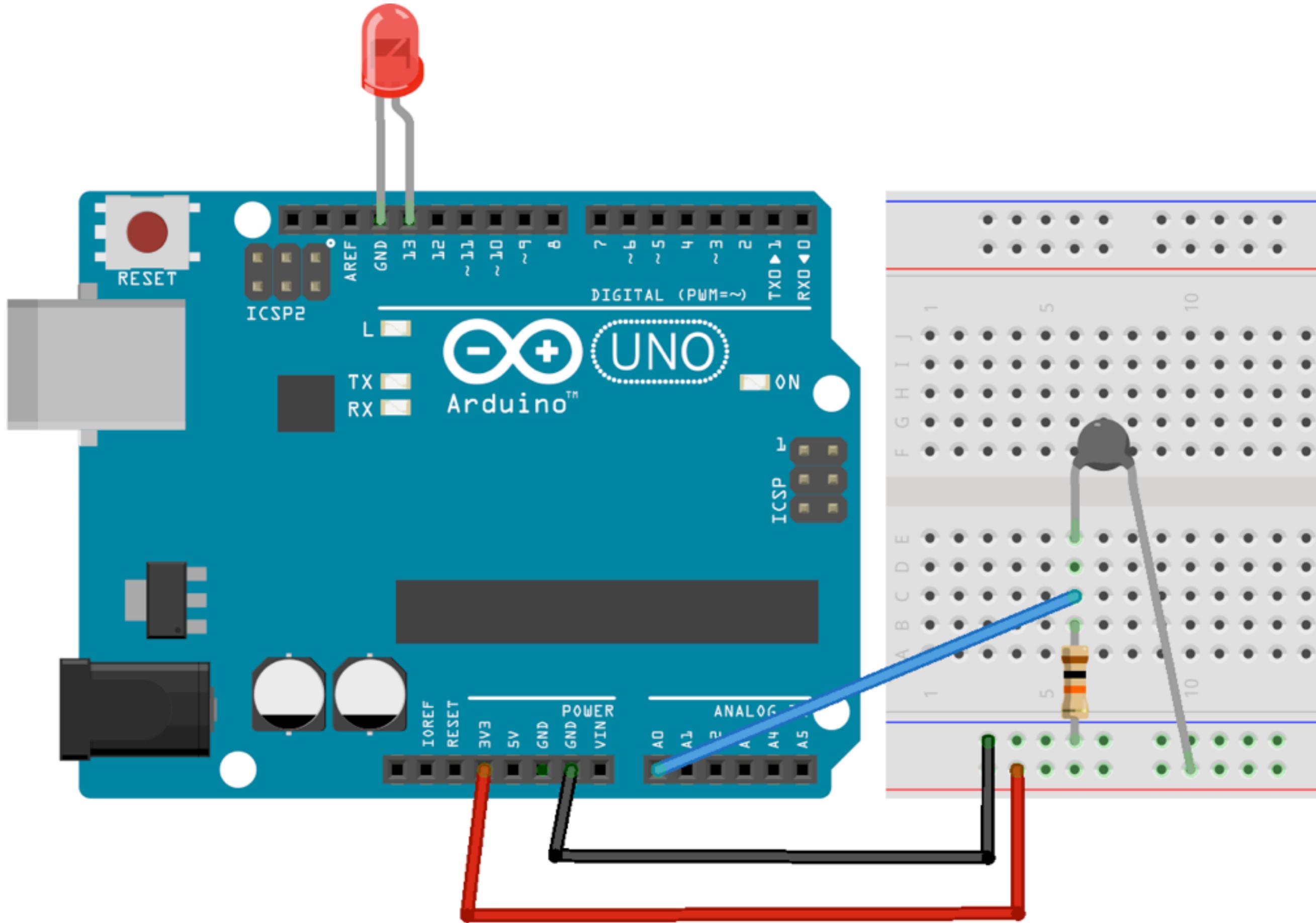
arduino uno



the circuit

My Light Temperature Sensor







Arduino

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Sketchbook ►

Examples ►

Close ⌘W

Save ⌘S

Save As... ⌘⌘S

Upload ⌘U

Upload Using Programmer ⌘⌘U

Page Setup ⌘⌘P

Print ⌘P

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02.Digital ►

03.Analog ►

04.Communication ►

05.Control ►

06.Sensors ►

07.Display ►

08.Strings ►

09.USB ►

10.StarterKit ►

ArduinolISP ►

Adafruit_NeoMatrix ►

Adafruit_NeoPixel ►

Time ►

TimeAlarms ►

EEPROM ►

Esplora ►

Ethernet ►

Firmata ►

GSM ►

AnalogInOutSerial

AnalogInput

AnalogWriteMega

Calibration

Fading

Smoothing



AnalogInput

```
int sensorPin = A0;      // select the input pin for the potentiometer
int ledPin = 13;          // select the pin for the LED
int sensorValue = 0;      // variable to store the value coming from the sensor

void setup() {
  // declare the ledPin as an OUTPUT:
  pinMode(ledPin, OUTPUT);
}

void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  // turn the ledPin on
  digitalWrite(ledPin, HIGH);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
  // turn the ledPin off:
  digitalWrite(ledPin, LOW);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
}
```

Blink 5

```
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/
// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
    // initialize the digital pin as an output.
    pinMode(led, OUTPUT);
}

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

Remember how we played with these numbers?



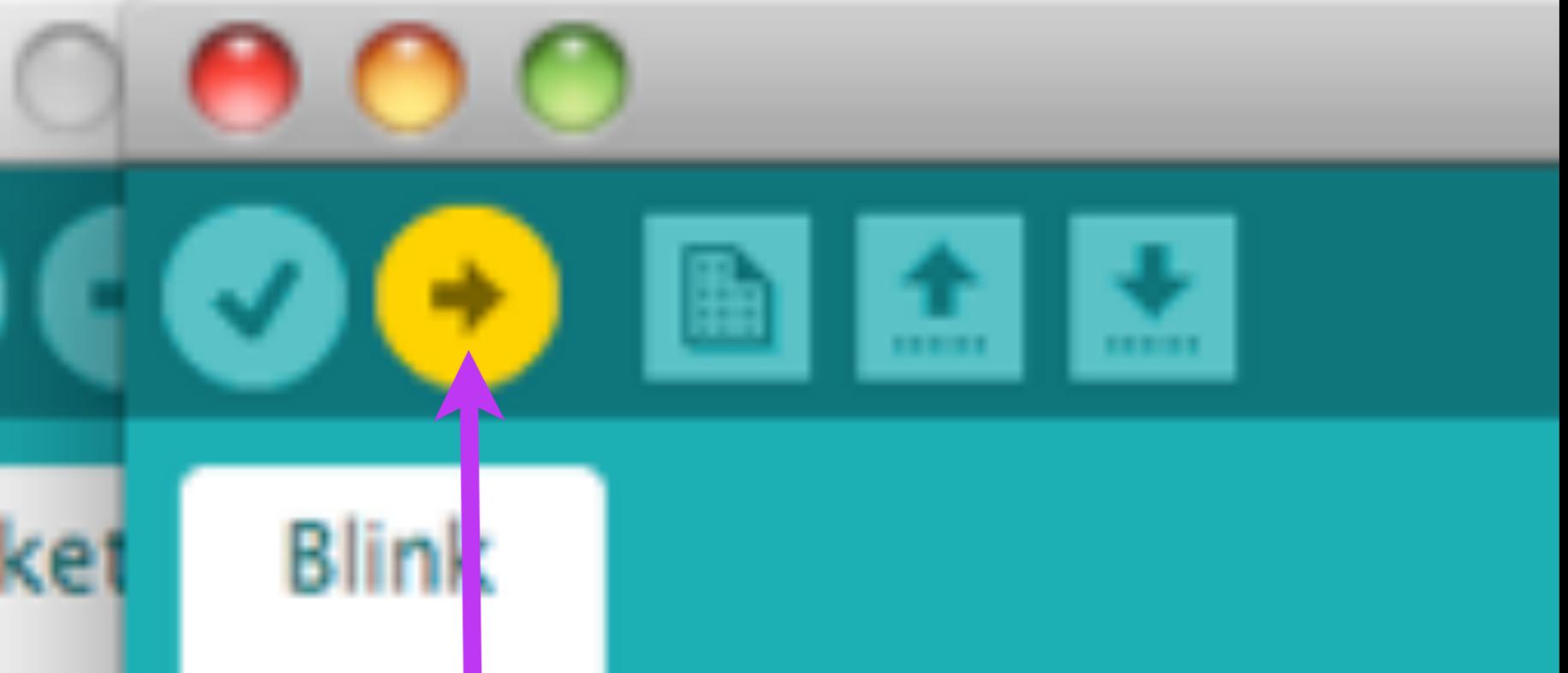
AnalogInput

```
int sensorPin = A0;      // select the input pin for the potentiometer
int ledPin = 13;          // select the pin for the LED
int sensorValue = 0;      // variable to store the value coming from the sensor

void setup() {
  // declare the ledPin as an OUTPUT:
  pinMode(ledPin, OUTPUT);
}

void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  // turn the ledPin on
  digitalWrite(ledPin, HIGH);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
  // turn the ledPin off:
  digitalWrite(ledPin, LOW);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
}
```

Arduino File Edit Sketch



```
/*
 * Blink
 * Turns on an LED on for one second,
 * then turns it off for one second,
 * repeatedly.
 *
 * This example code is in the public domain.
 */
// Pin 13 has an LED connected
```

the
“Serial Monitor”

```
int sensorValue = 0; // variable to store the value coming from the sensor

void setup() {
  // declare the ledPin as an OUTPUT:
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);

}

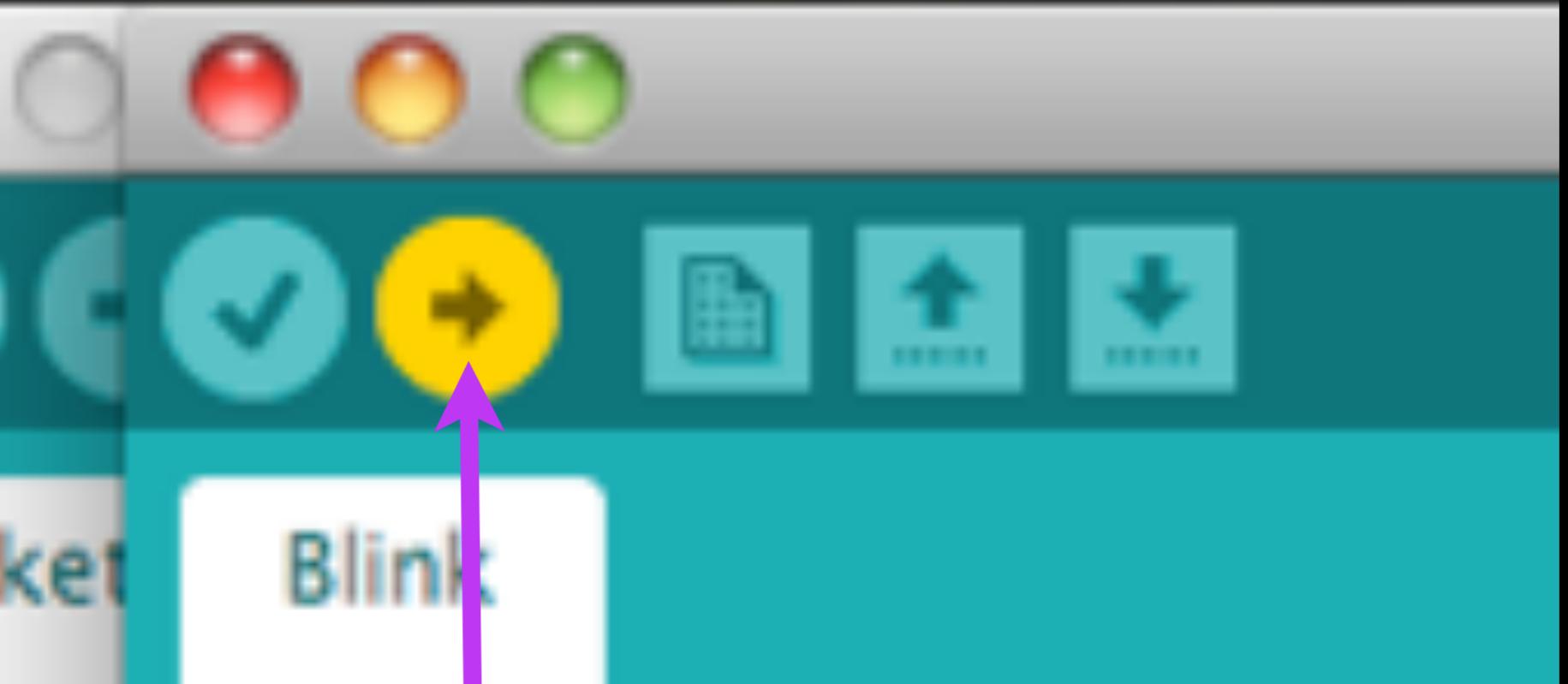
void loop() {
  // read the value from the sensor:
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);
  // turn the LED on:
  digitalWrite(ledPin, HIGH);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
  // turn the ledPin off:
  digitalWrite(ledPin, LOW);
  // stop the program for <sensorValue> milliseconds:
  delay(sensorValue);
}


```

Serial.begin (9600) ;

Serial.println (sensorValue) ;

Arduino File Edit Sketch



```
/*
 * Blink
 *
 * Turns on an LED on for one second,
 * then turns it off for one second,
 * repeatedly.
 *
 * This example code is in the public domain.
 */
// Pin 13 has an LED connected
```



Arduino

File Edit Sketch

Tools

Help

Auto Format ⌘T

Archive Sketch

Fix Encoding & Reload

Serial Monitor ↑⌘M

Board ▶

Serial Port ▶

Programmer ▶

Burn Bootloader ▶

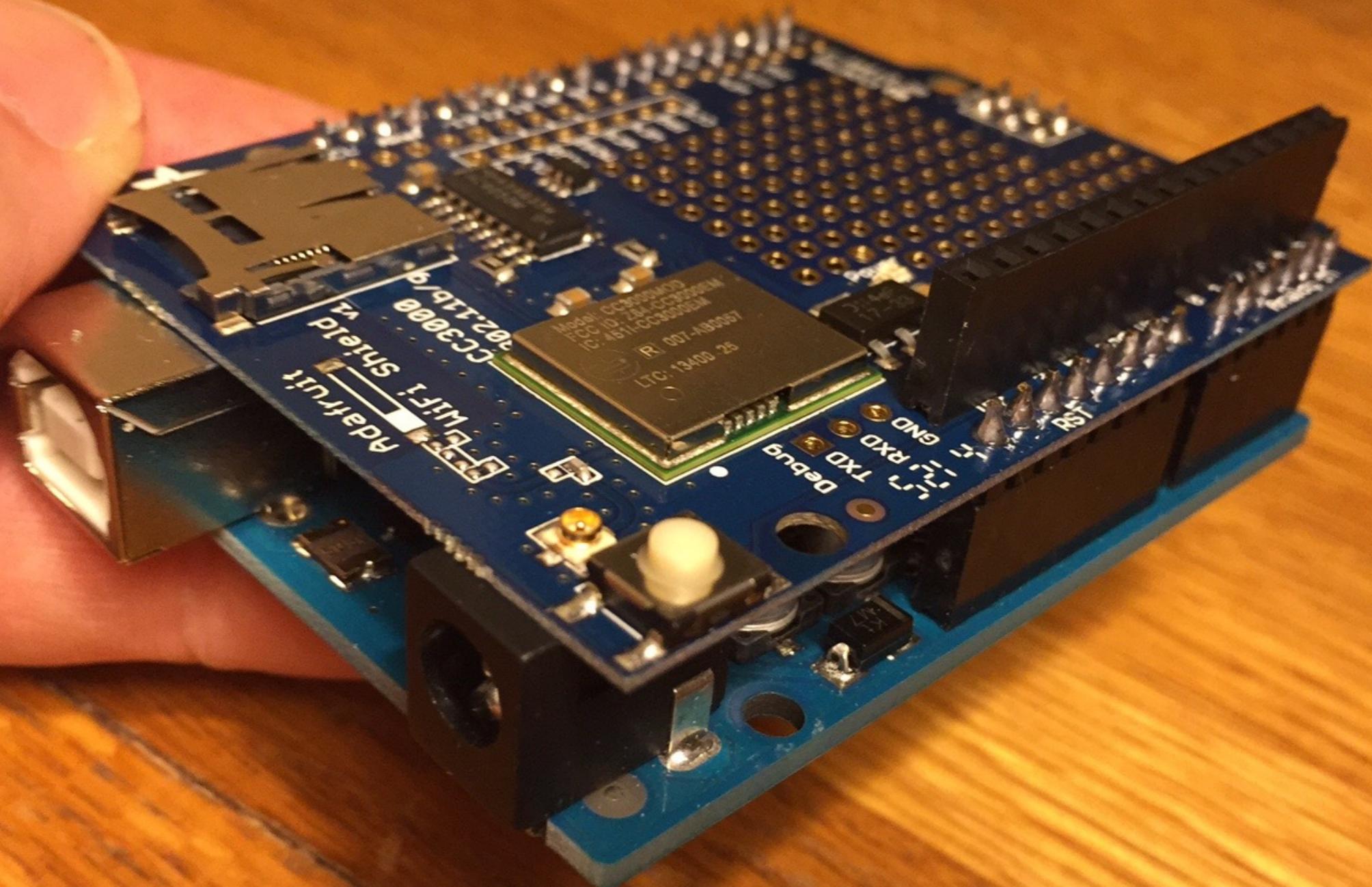
calibration
[kinda]

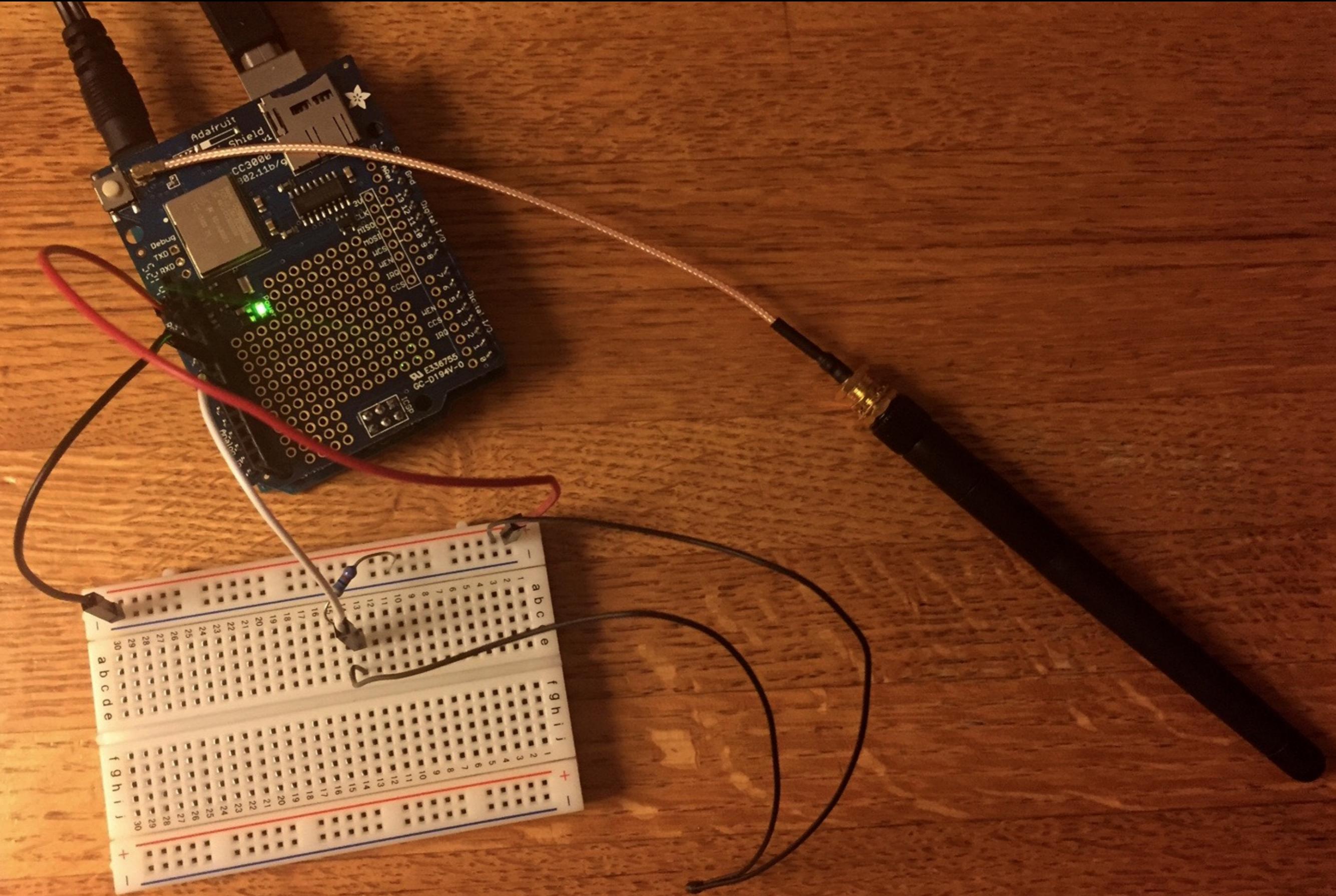


AnalogInput §

```
void setup() {  
    // declare the ledPin as an OUTPUT:  
    pinMode(ledPin, OUTPUT);  
    Serial.begin(9600);  
}  
  
void loop() {  
    // read the value from the sensor:  
    sensorValue = analogRead(sensorPin);  
    Serial.println(sensorValue / 5.2);  
    // turn the ledPin on  
    digitalWrite(ledPin, HIGH);  
    // stop the program for <sensorValue> milliseconds:  
    delay(sensorValue);  
    // turn the ledPin off:  
    digitalWrite(ledPin, LOW);  
    // stop the program for for <sensorValue> milliseconds:  
    delay(sensorValue);  
}
```

```
Serial.println(sensorValue/4.3);
```





[http://data.sparkfun.com/input/
xR0K32a8yGC67Vvdlog1?
private_key=secretkey&temp=444](http://data.sparkfun.com/input/xR0K32a8yGC67Vvdlog1?private_key=secretkey&temp=444)

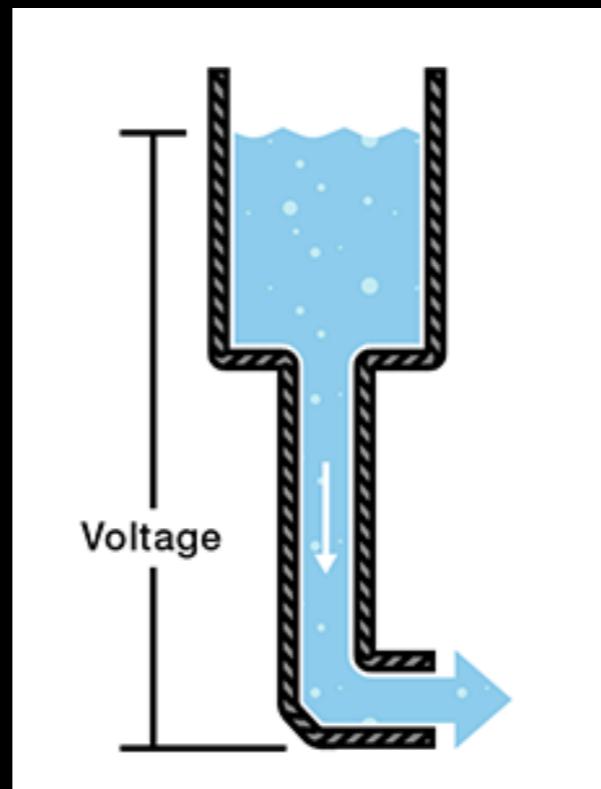
see it at
bit.ly/nicar-temp

where to go next:
teamblinky.com
arduino.cc
adafruit.com
sparkfun.com

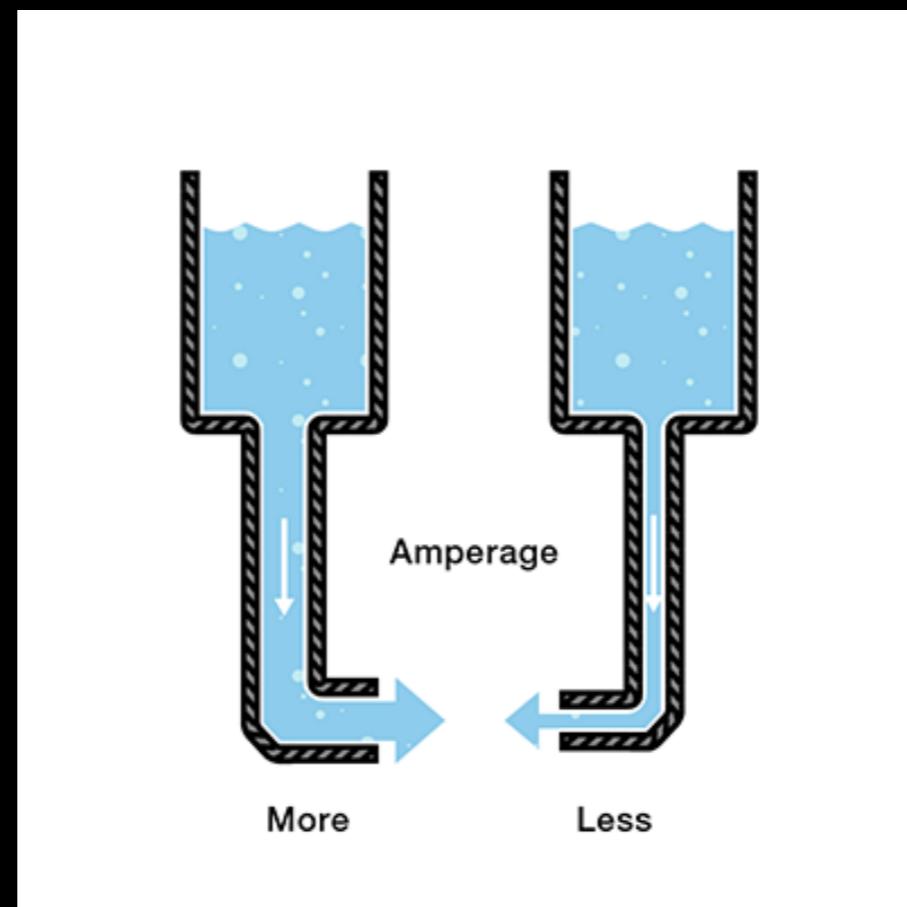
quick primer on electricity

[don't run away
just yet]

voltage is
the difference in
charge between two
points.



current is the rate
at which charge is
flowin.



resistance is a material's tendency to resist the flow of charge (current) .

