Arduino
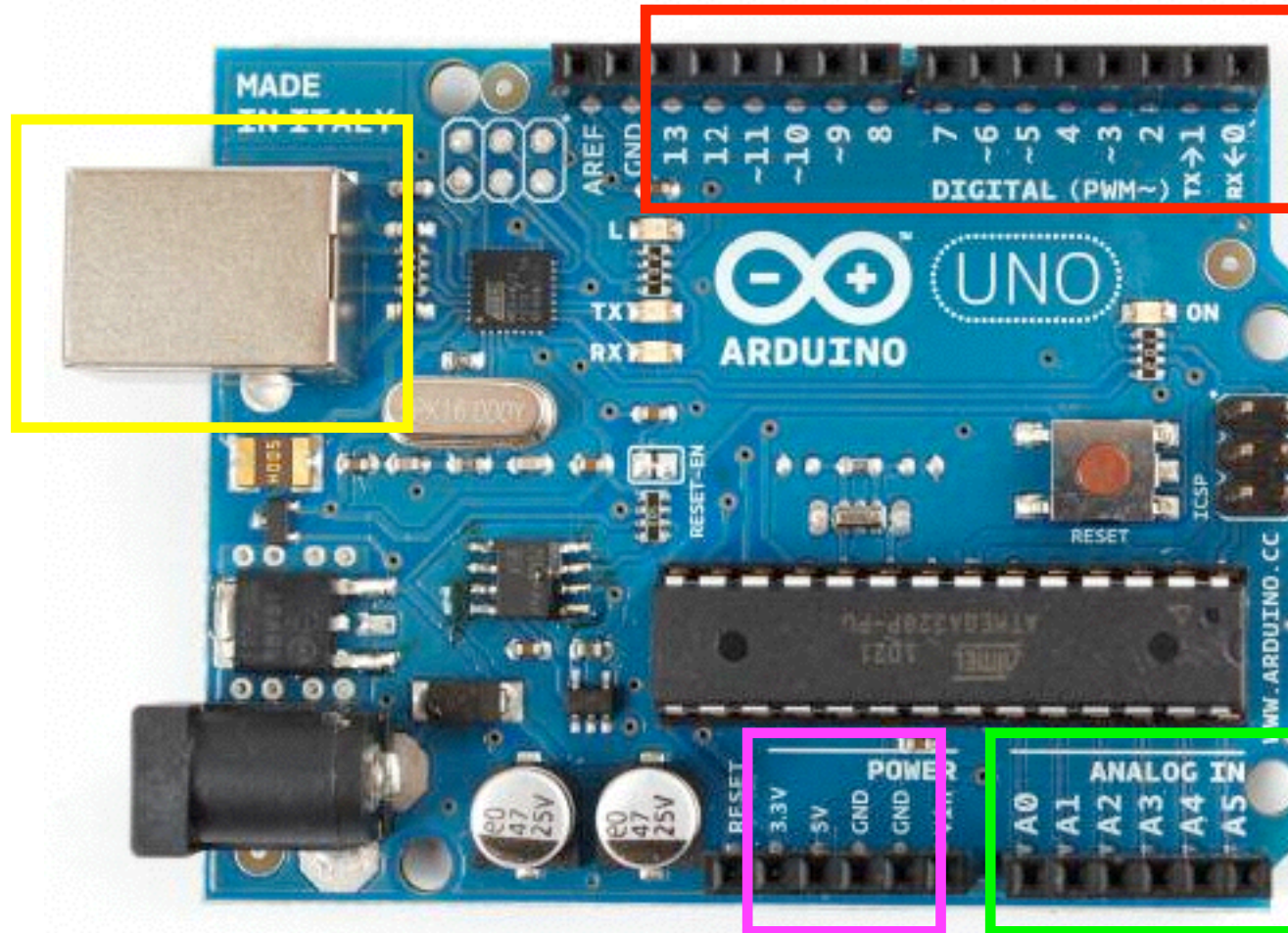

Digital inputs/outputs

USB

Power / Analog inputs

Ground

Voltage and Current

- Voltage = electric potential between two points
- Measured in volts (V)
- Ground = common reference point

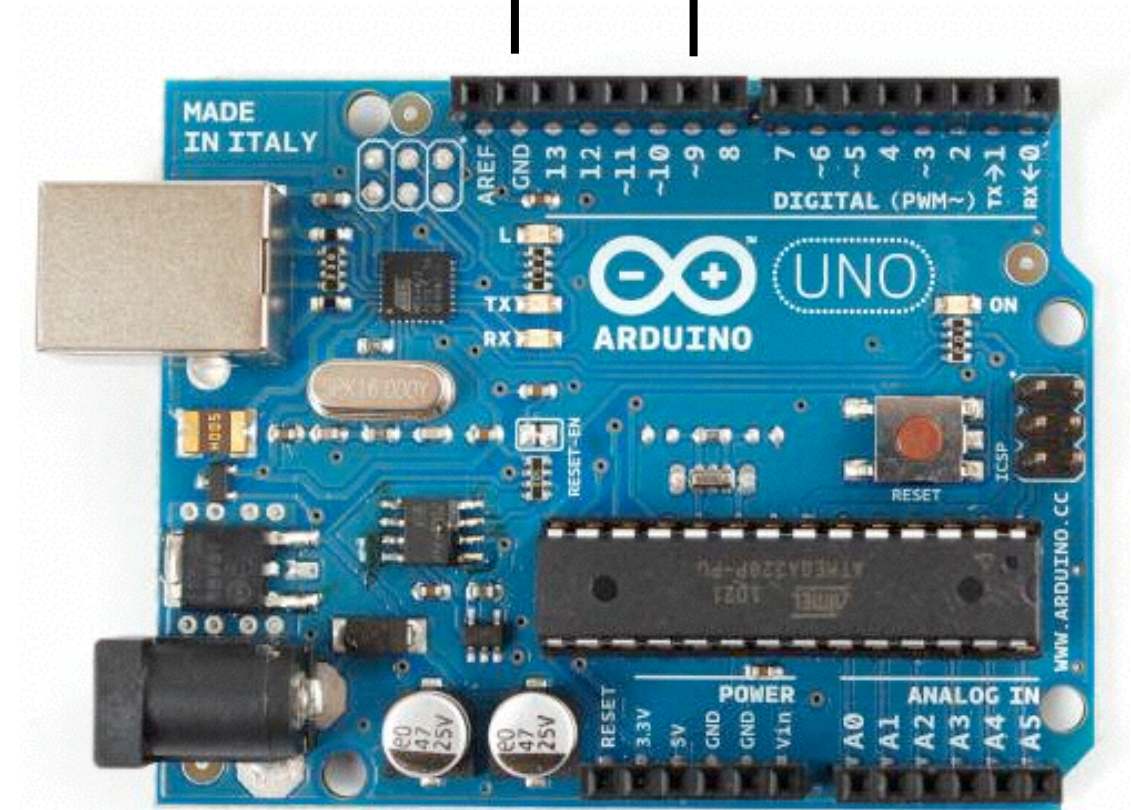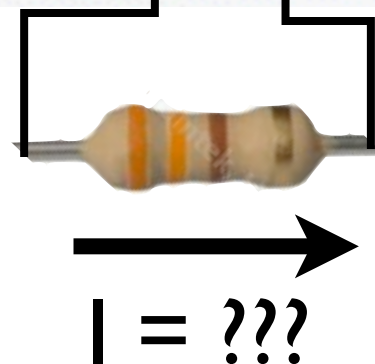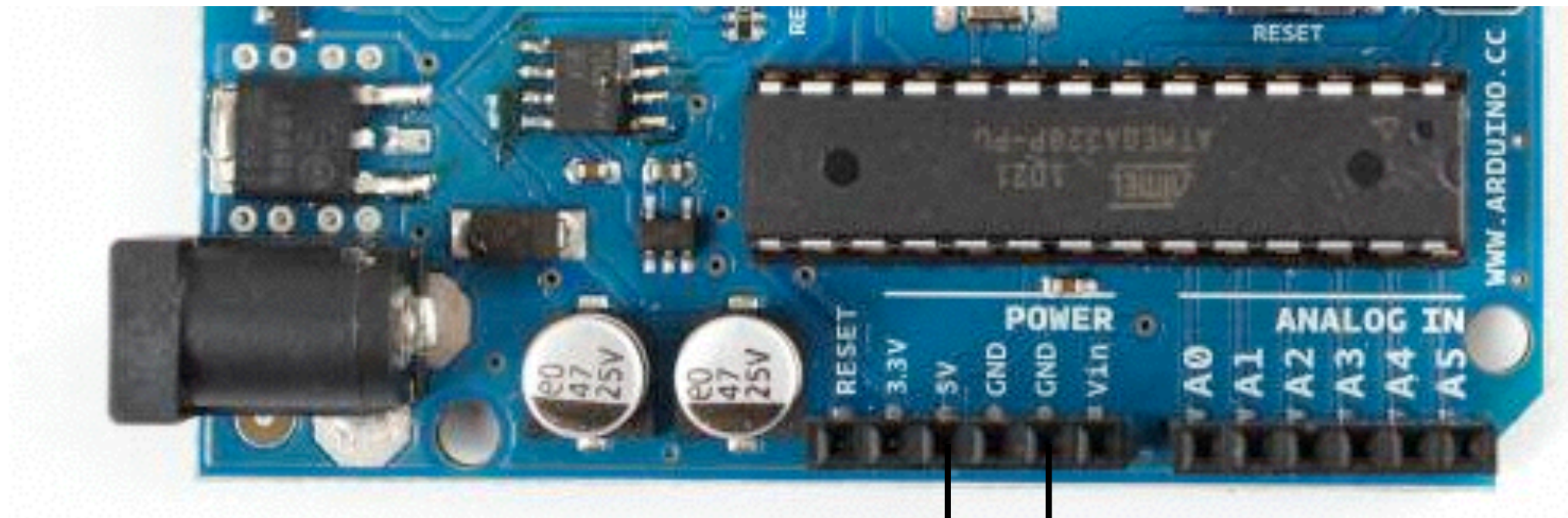What is the voltage between pin 9 and ground?
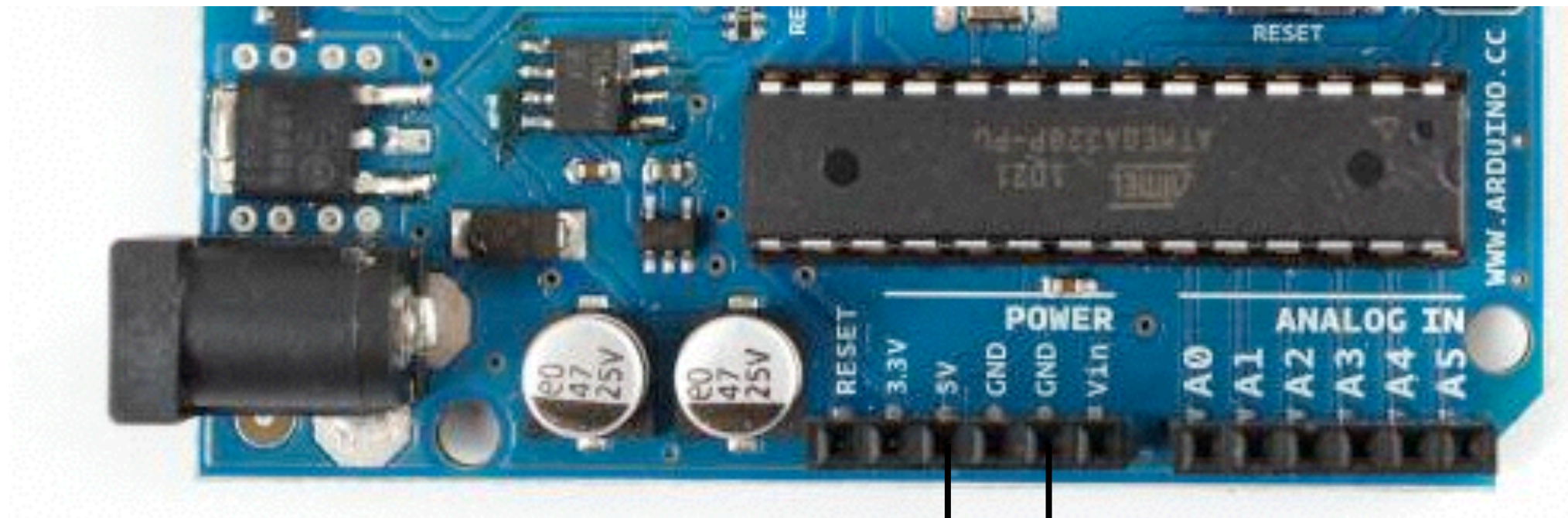
9V

1.5V

240V

??

5V

Voltage and Current

- Current = rate at which electric charge flows through a wire/circuit
- Measured in amps (A) or milliamps (mA)

I = ???

V = IR

- Ohm's Law: voltage = current times resistance
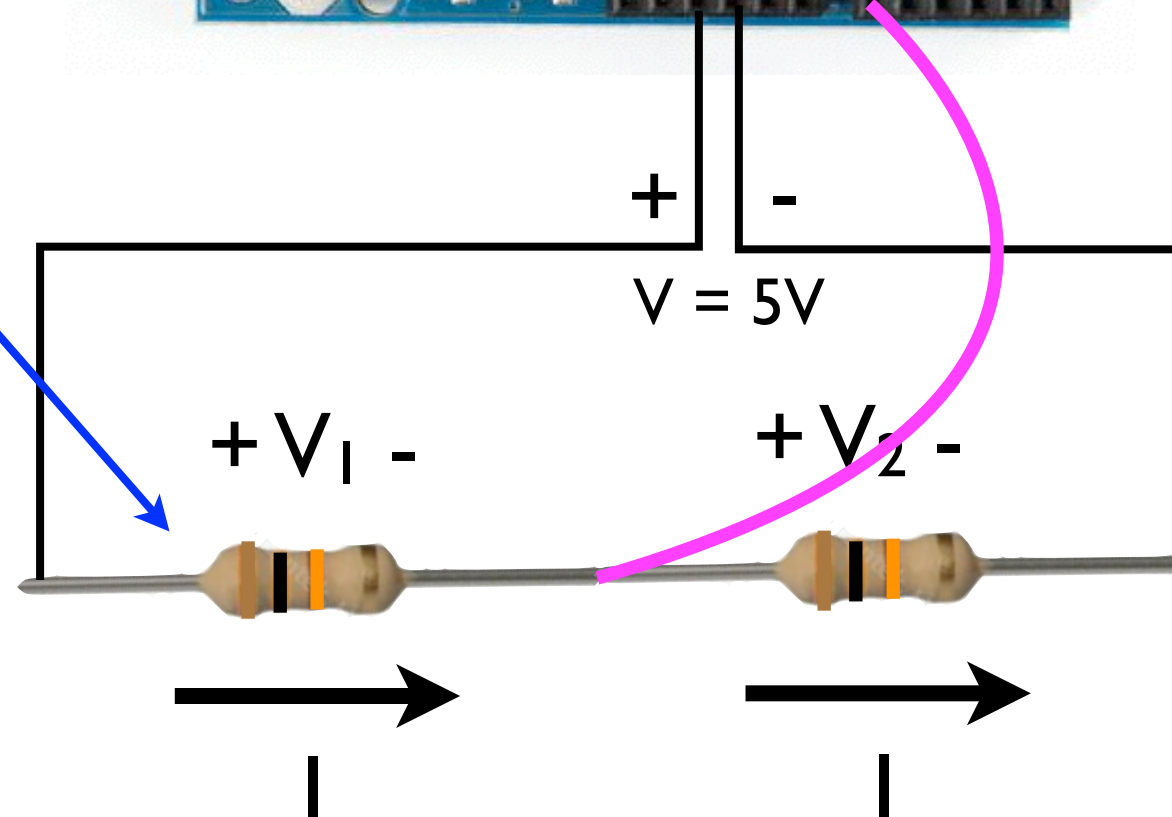- Equivalently: I = V/R

V = 5V
R = 330Ω

I = 5V / 330Ω
I = .015A = 15mA

Series and Parallel

Use 2 10kΩ resistors

$+$ $-$

$V = 5V$

$+ V_1 -$ $+ V_2 -$

I I

$V_1 + V_2 = 5V$

...so what is V_2?

Series and Parallel

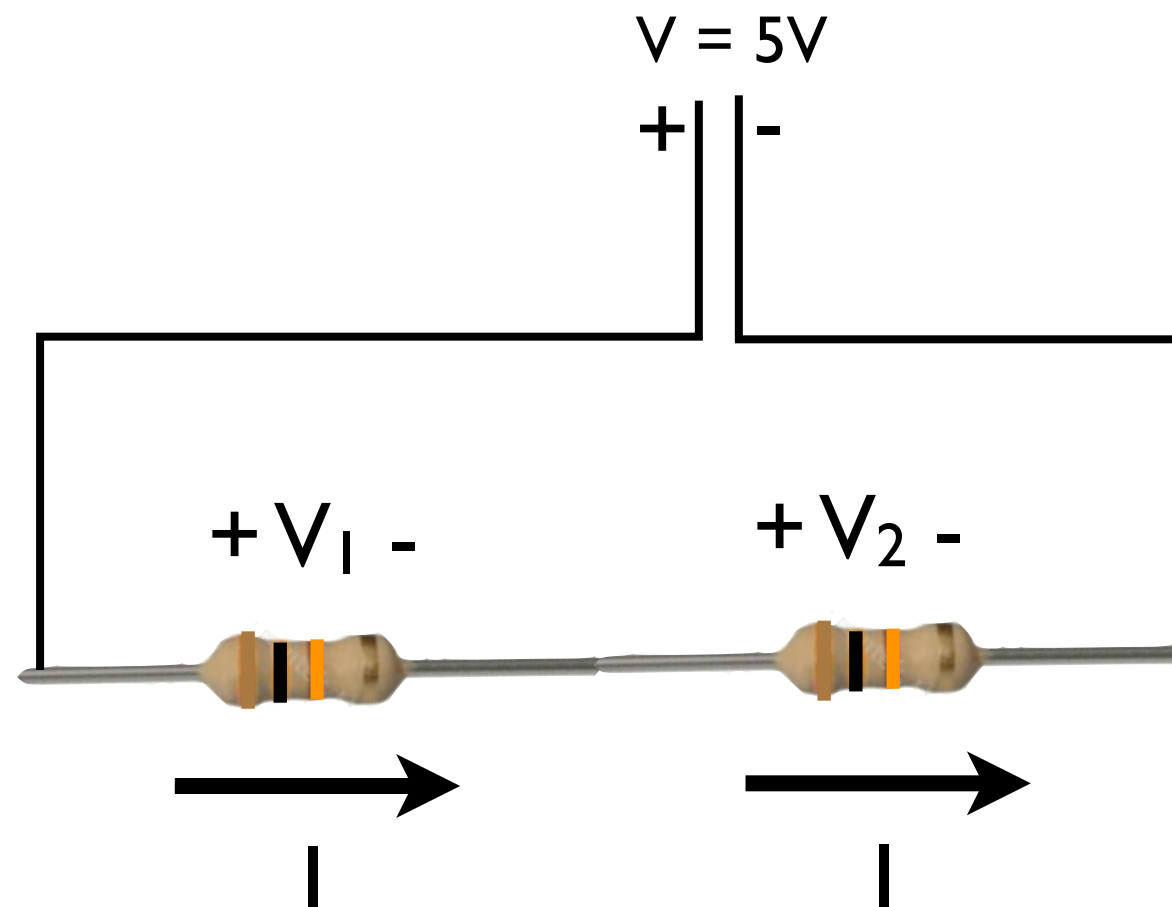$$V = IR$$

$$V_1 + V_2 = 5V$$

$$IR_1 + IR_2 = 5V$$

$$I = 5V / (R_1 + R_2) = 5V / 20k\Omega = 0.25mA$$

$$V_2 = IR_2 = 2.5V$$

V = 5V

+ | -

+ V₁ -   + V₂ -

I   I

Series and Parallel

+ V -

I

I_1

+ V -

I_2

Same voltage across each device, different current:
$I = I_1 + I_2$
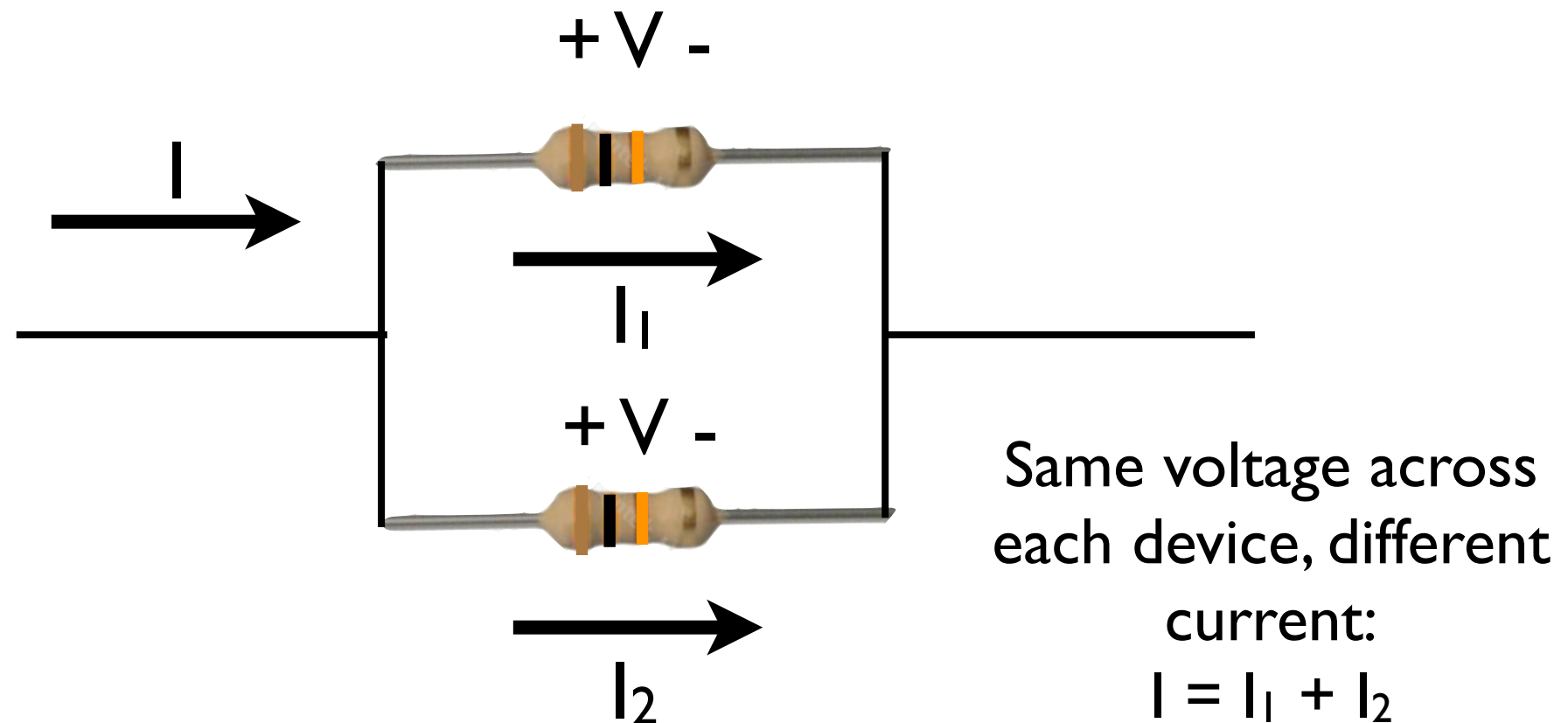
- Handy rules for series and parallel resistors:
  - In series: $R_{total} = R_1 + R_2$
  - In parallel: $R_{total} = (R_1 R_2) / (R_1 + R_2)$

Resistors and LEDs

For LEDs, always the same voltage drop across the device. About 1.7V for a red LED

pin 9

330Ω resistor

GND (ground)
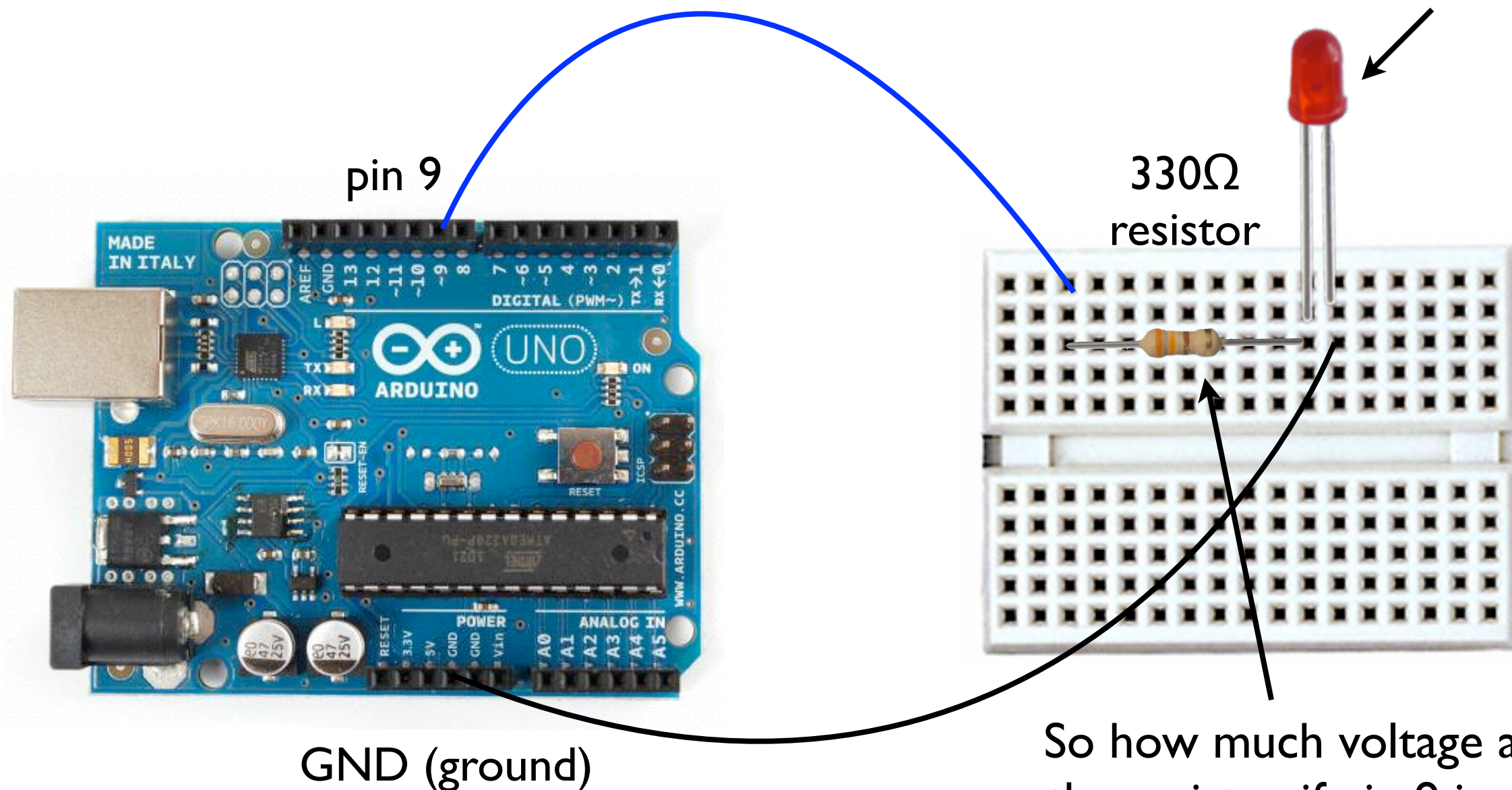
So how much voltage across the resistor if pin 9 is at 5V?

...and how much current?

Resistors

...resist the flow of electric current

330Ω

Resistance is measured in ohms

| Color	1st	2nd	Multiplier	Tolerance
Black	0	0	1	
Brown	1	1	10	±1%
Red	2	2	100	±2%
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	±0.5%
Blue	6	6	1,000,000	±0.25%
Violet	7	7	10,000,000	±0.1%
Gray	8	8	100,000,000	±0.05%
White	9	9	1,000,000,000	
Gold			0.10	±5%
Silver			0.01	±10%
None				±20%

Resistor Colour Code

RGB LEDs

3 LED elements in one package:
Red, Green, Blue
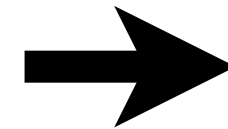
So where do we
find the pinout?

RGB LEDs

9.8
10.8
11.5
2
min25±0.5
0.5
1.25
1.25
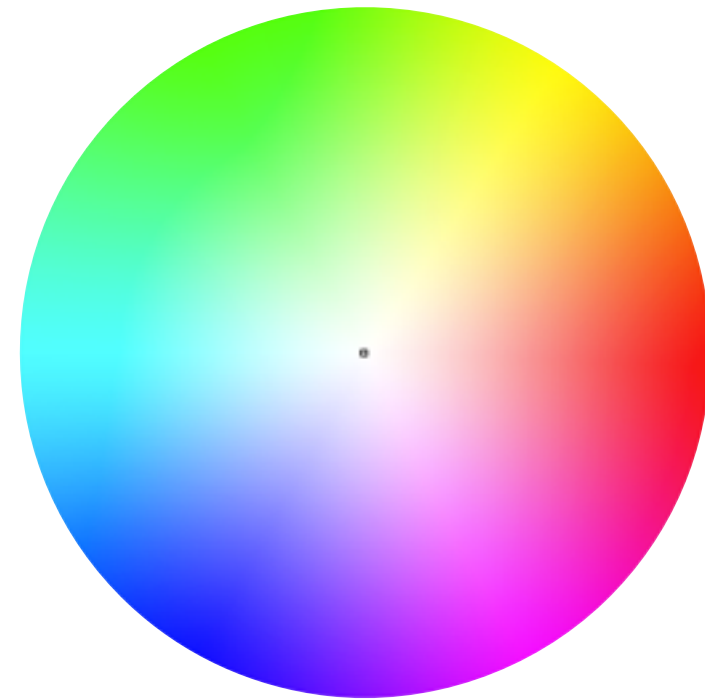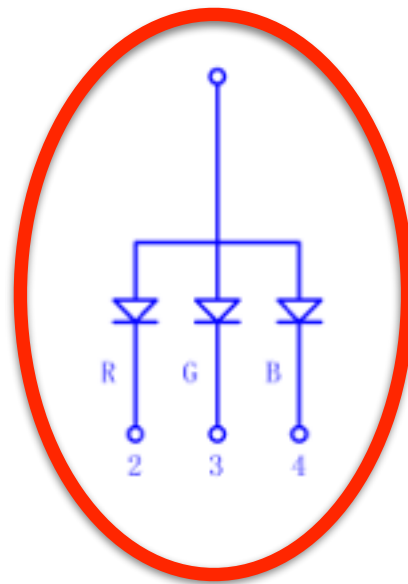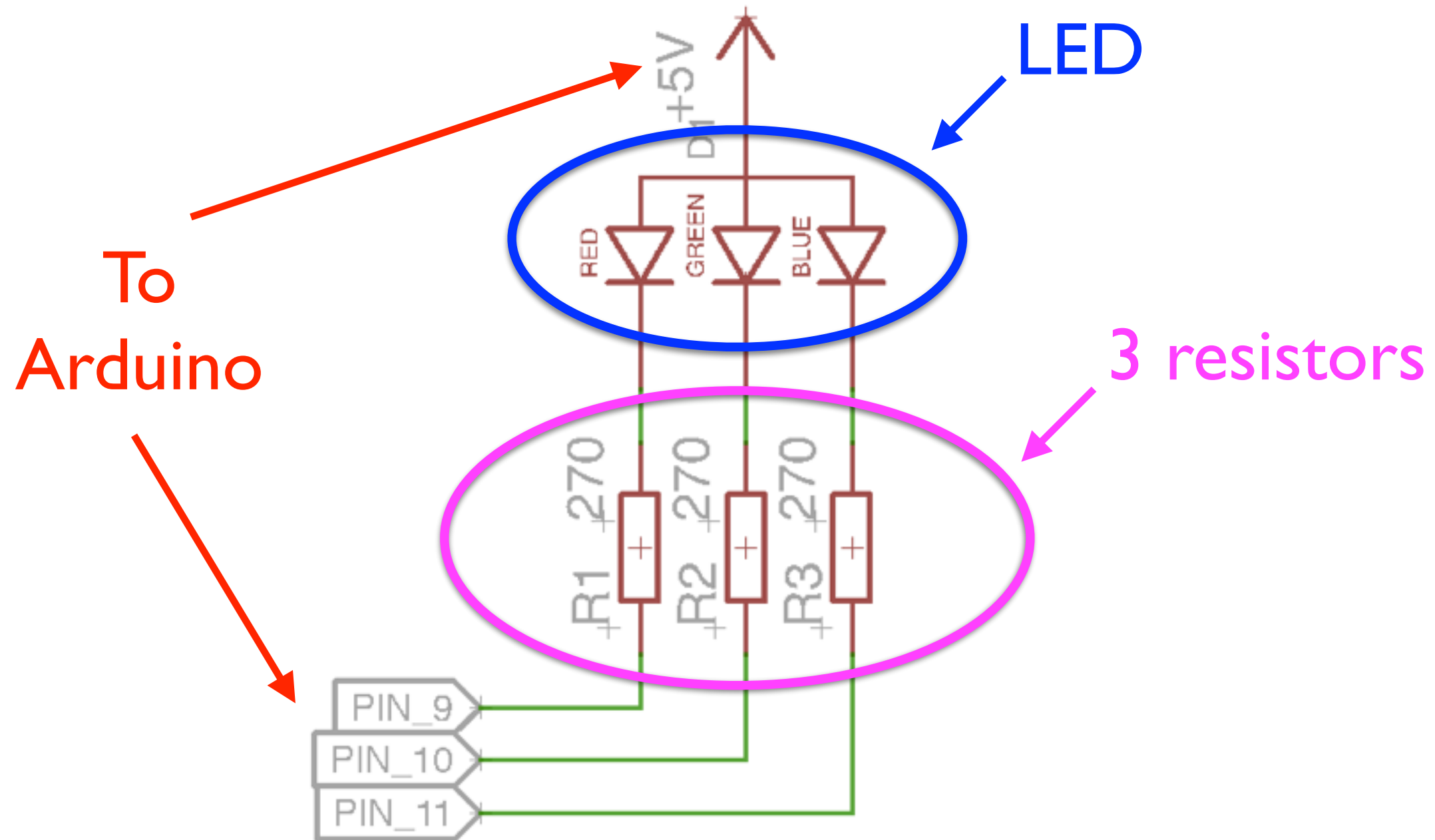
1   2
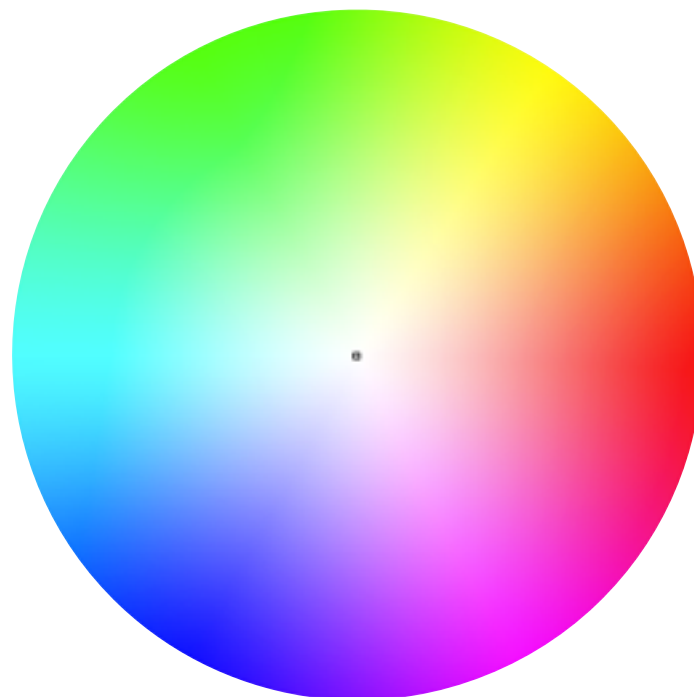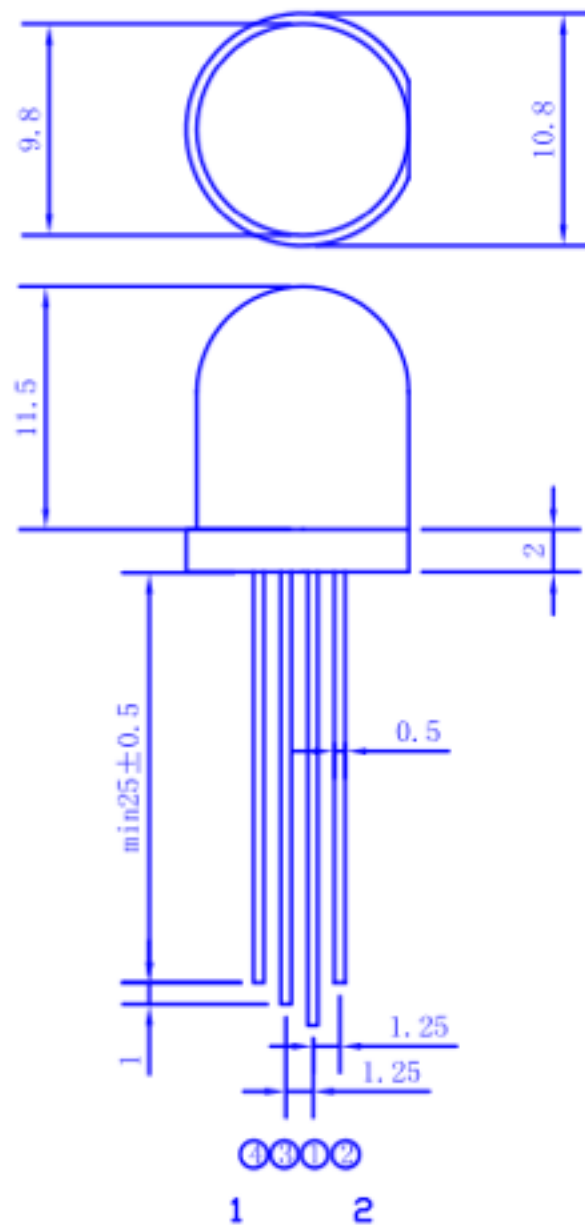
PIN2 RED COLOR DICE
PIN3 GREEN COLOR DICE
PIN4 BLUE COLOR DICE

□ 0.5 SQUARE*2

R   G   B

2   3   4

Notice: common anode means the
positive side of each LED is shared.

RGB LEDs

Fading sketch

analogWrite()

What is the range of values?

for(start; finish; increment) {
    // stuff in the loop
}

```
Fading | Arduino 1.0-rc1

Fading

int ledPin = 9;    // LED connected to digital pin 9

void setup()  {
  // nothing happens in setup
}

void loop()  {
  // fade in from min to max in increments of 5 points:
  for(int fadeValue = 0 ; fadeValue <= 255; fadeValue +=5) {
    // sets the value (range from 0 to 255):
    analogWrite(ledPin, fadeValue);
    // wait for 30 milliseconds to see the dimming effect
    delay(30);
  }

  // fade out from max to min in increments of 5 points:
  for(int fadeValue = 255 ; fadeValue >= 0; fadeValue -=5) {
    // sets the value (range from 0 to 255):
    analogWrite(ledPin, fadeValue);
    // wait for 30 milliseconds to see the dimming effect
    delay(30);
  }
}

8                    Arduino Duemilanove w/ ATmega328 on /dev/tty.usbserial-A9007ONC
```
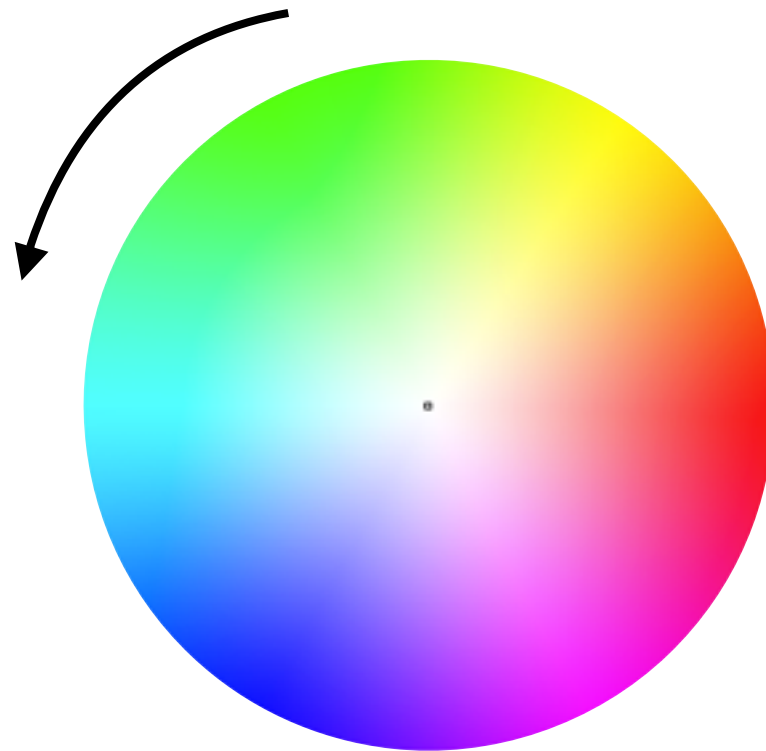
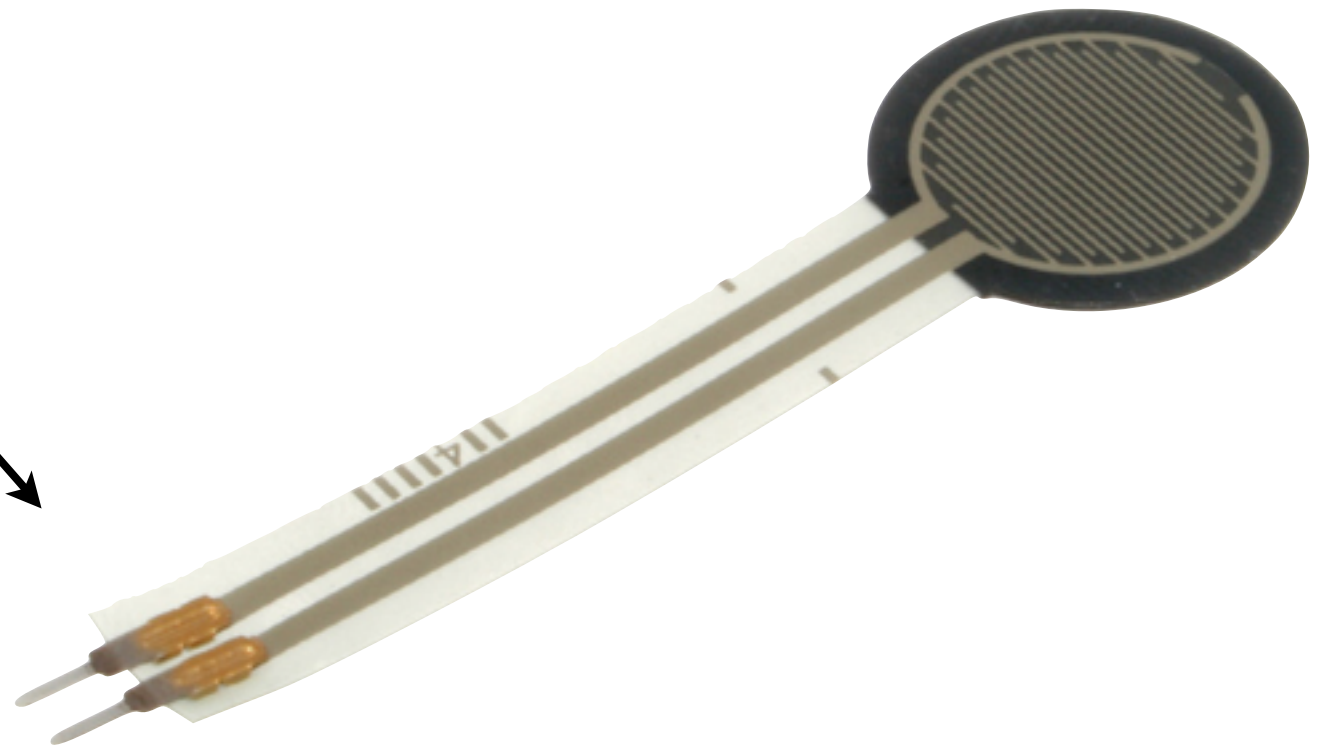# Task: change the Fading sketch to cycle through all the colours

Using an FSR*

* Force-Sensing Resistor

The FSR changes its resistance
according to the amount of force
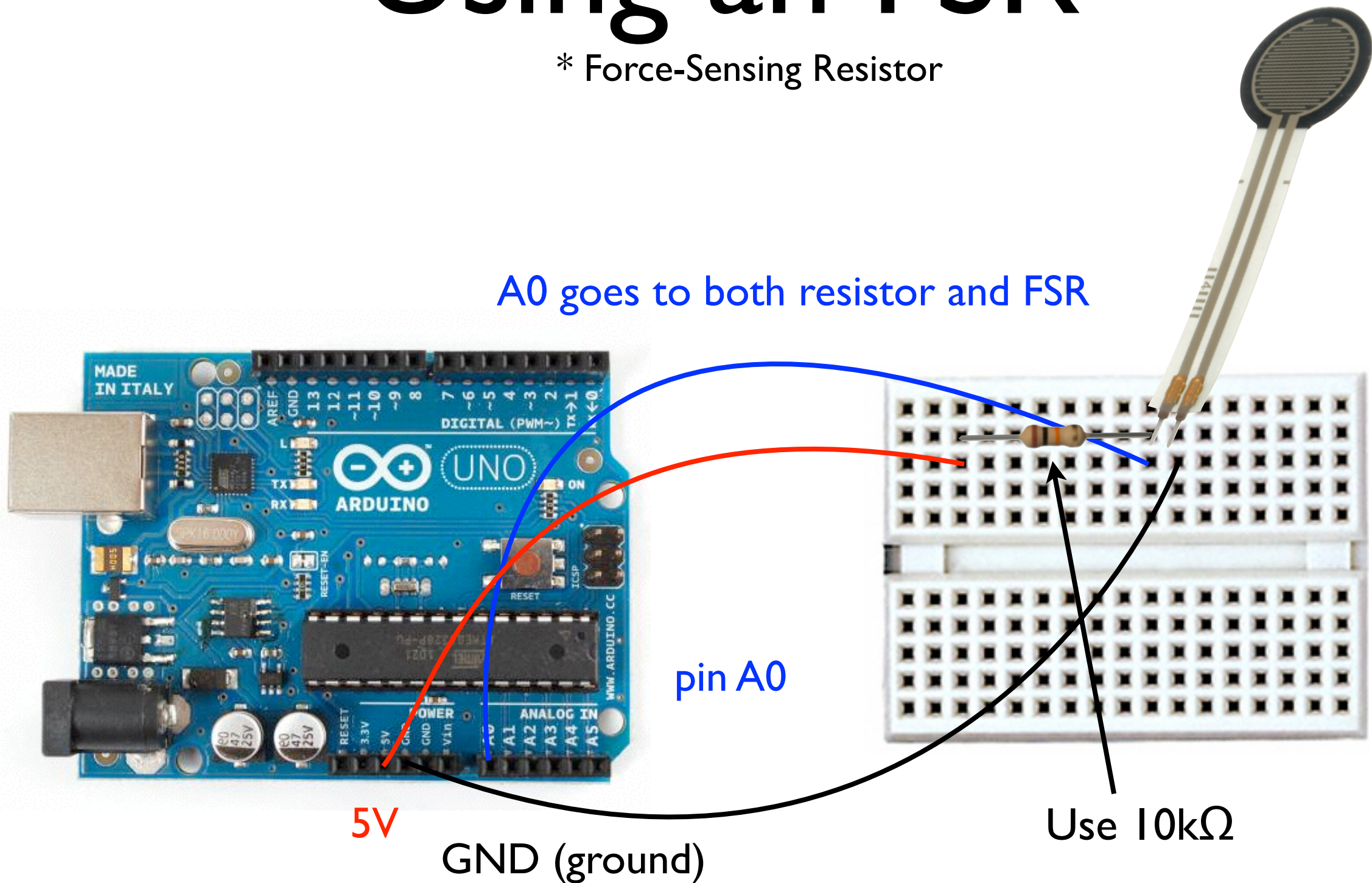exerted on it

How should we hook it up??

How should we hook it up
so we get a changing voltage?

Using an FSR*

* Force-Sensing Resistor

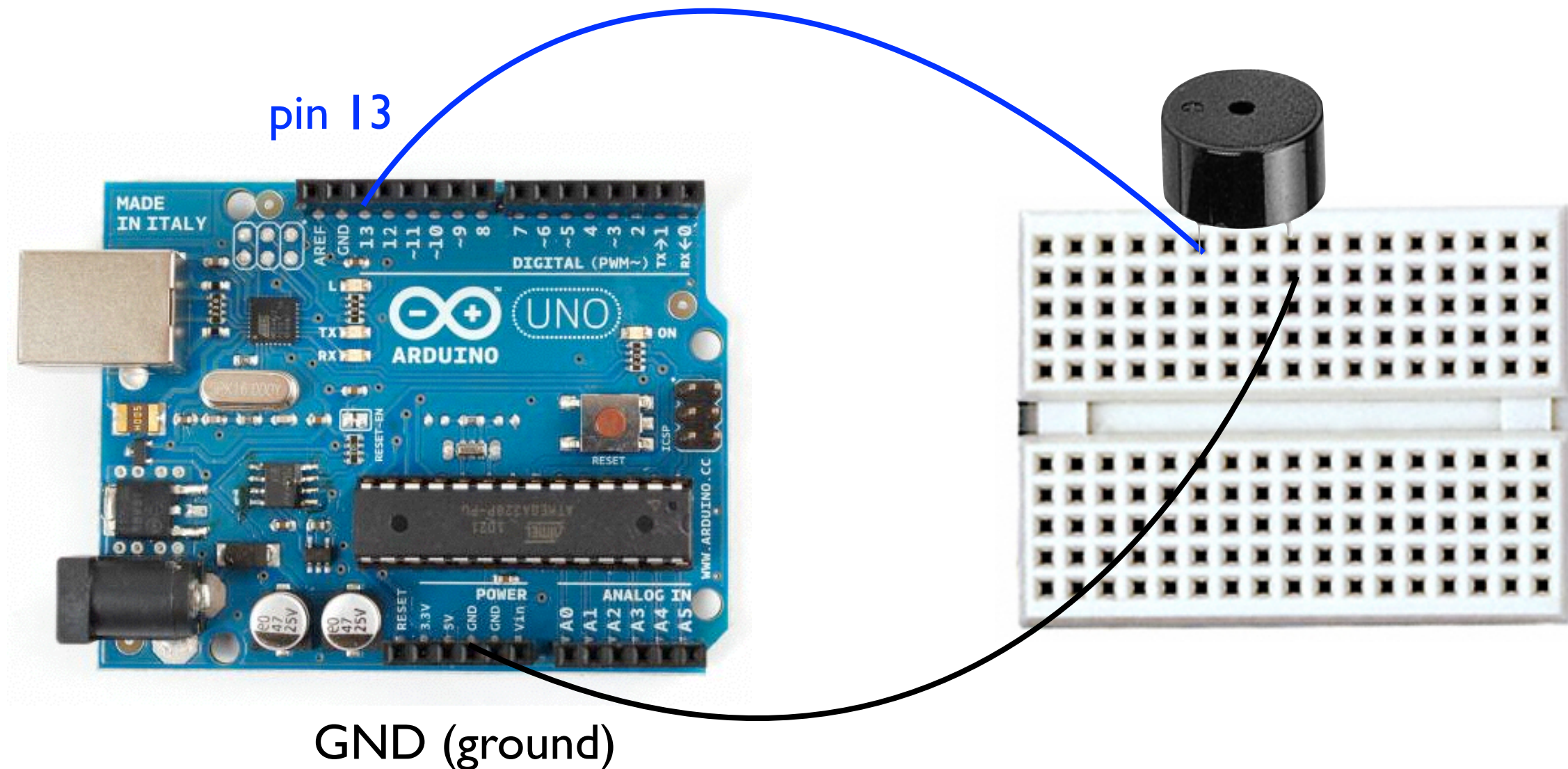A0 goes to both resistor and FSR

pin A0

5V

GND (ground)

Use 10kΩ

Use AnalogReadSerial sketch

Connect the speaker

Important: 2 types of speaker!
We are using a piezo buzzer: connects directly to Arduino
Standard (larger) speakers need special circuitry to drive

pin 13

GND (ground)

Upload the Blink sketch

What does this sound like?

And what does this sound like?


```
Blink | Arduino 1.0-rc1

Blink

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

  This example code is in the public domain.
*/

void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);    // set the LED on
  delay(1000);               // wait for a second
  digitalWrite(13, LOW);     // set the LED off
  delay(1000);               // wait for a second
}

Upload canceled.
Binary sketch size: 1026 bytes (of a 30720 byte maximum)

1          Arduino Duemilanove w/ ATmega328 on /dev/tty.usbserial-A9007ONC
```