

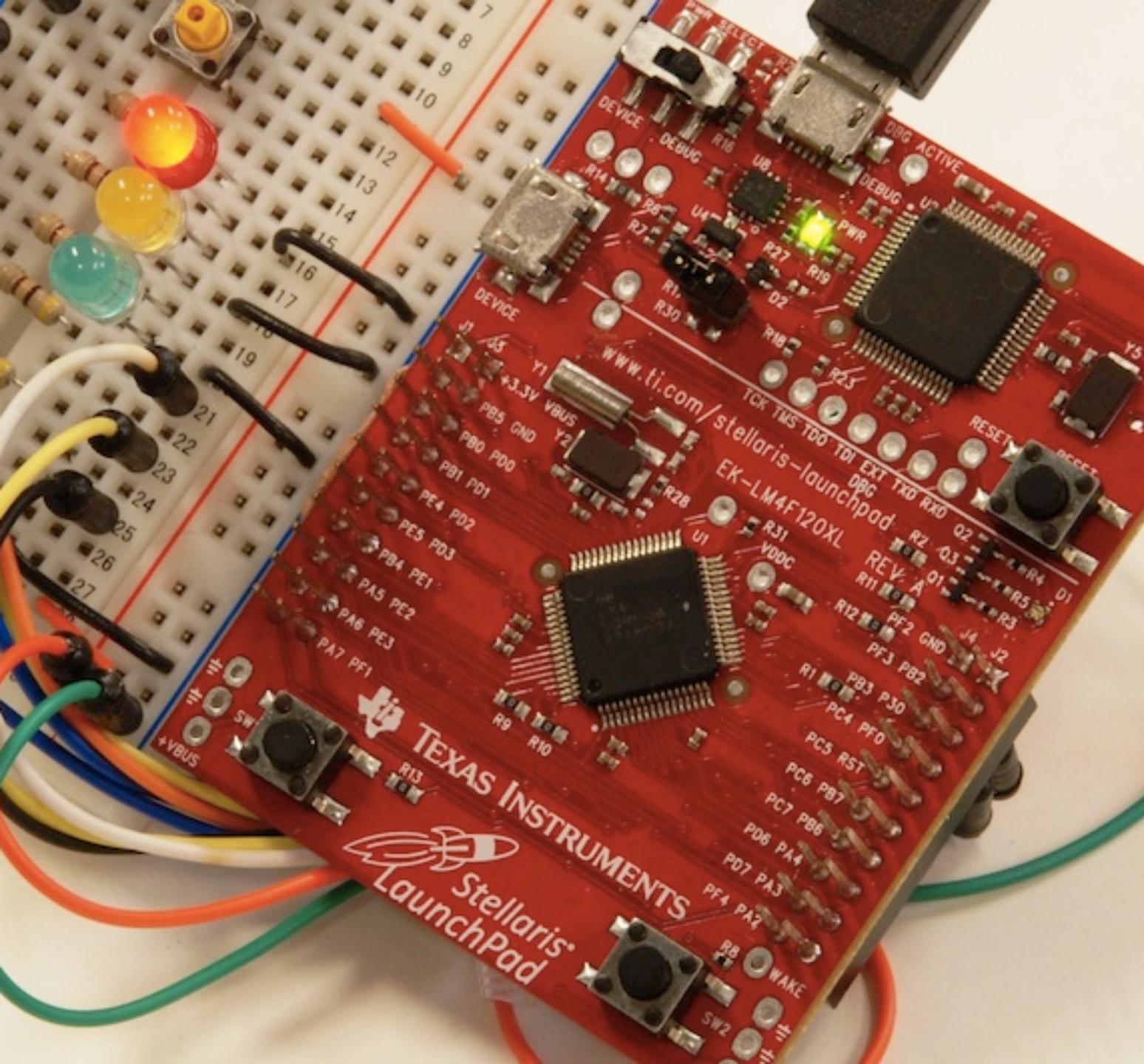
Introduction to Arduinos

By Crystal Hess

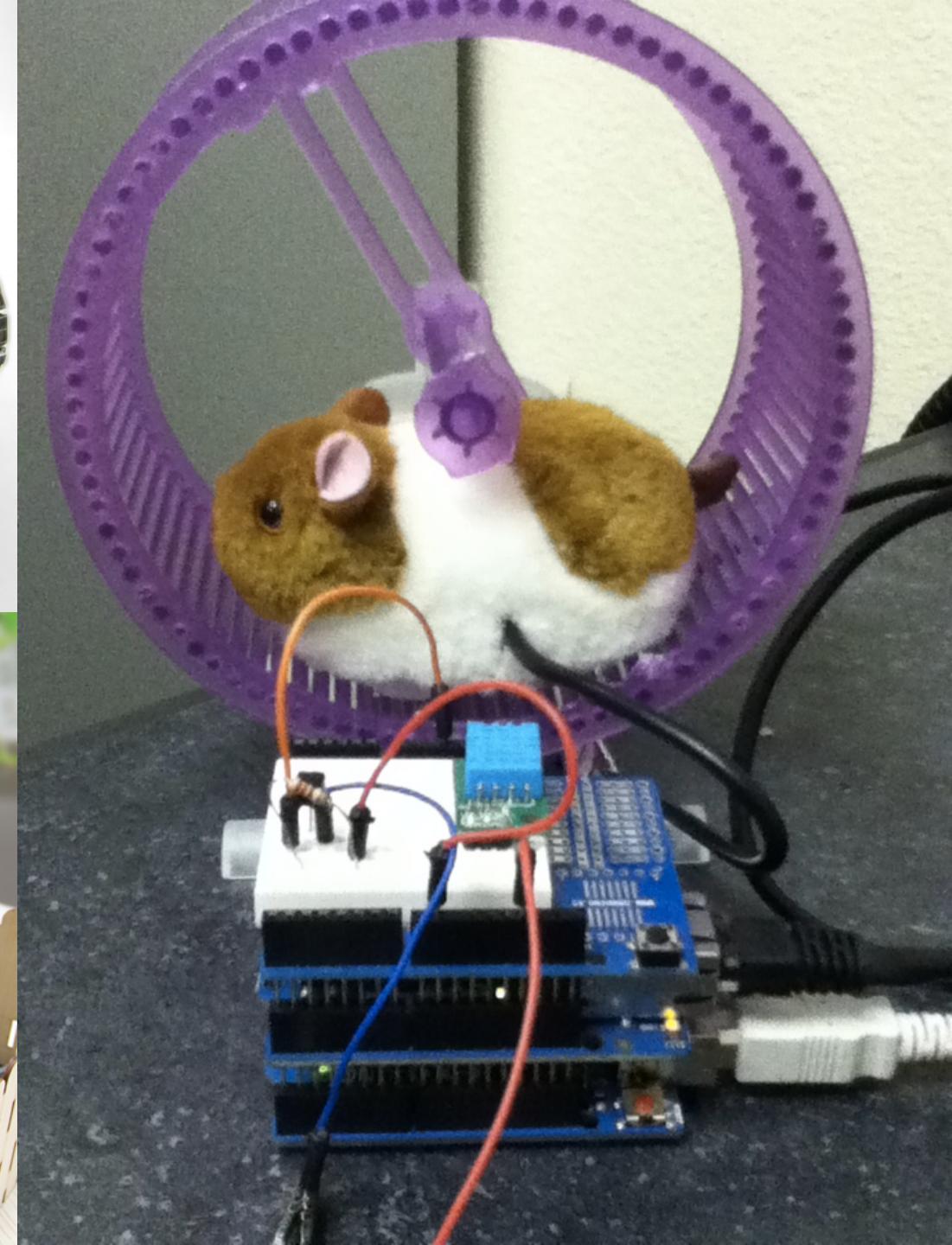
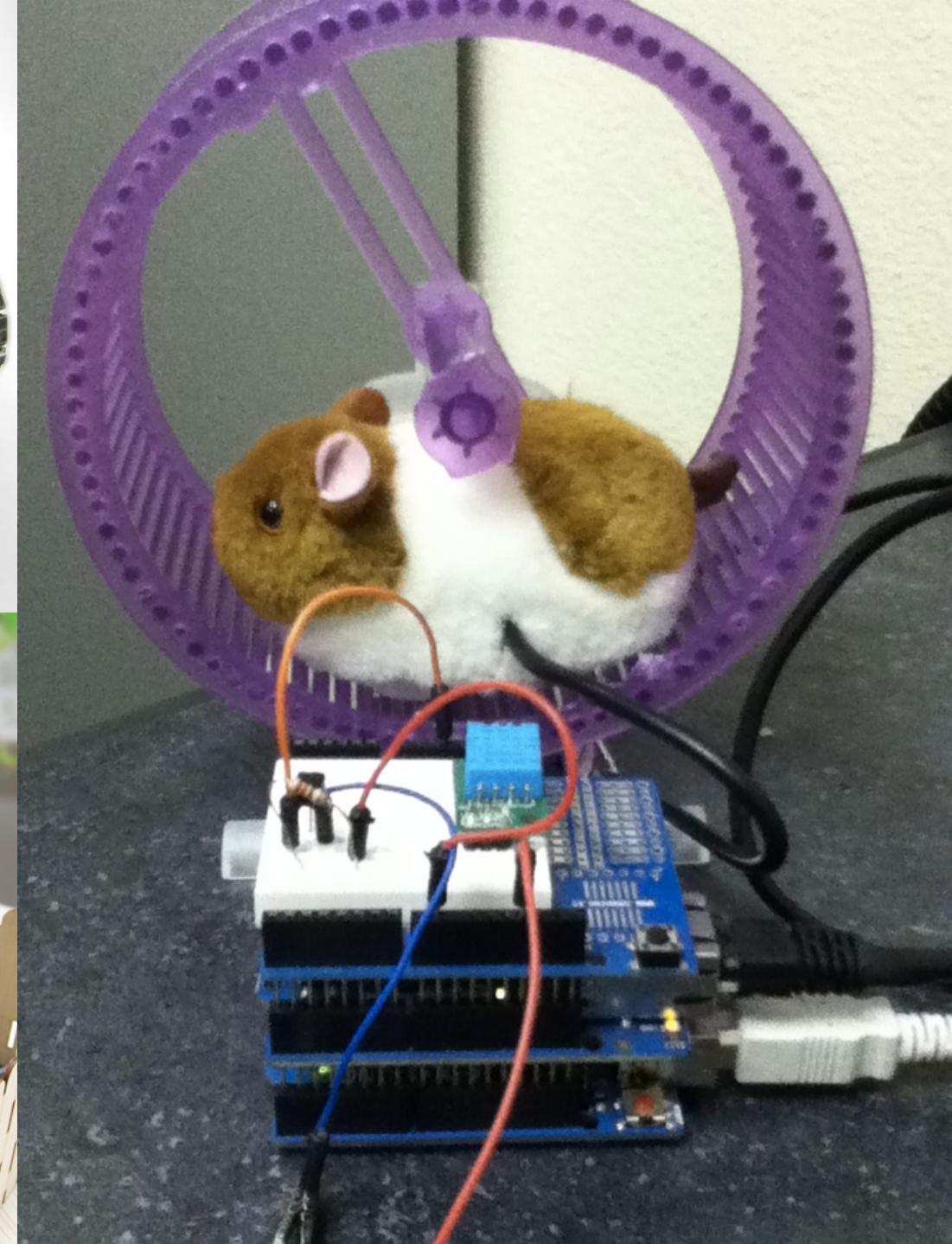
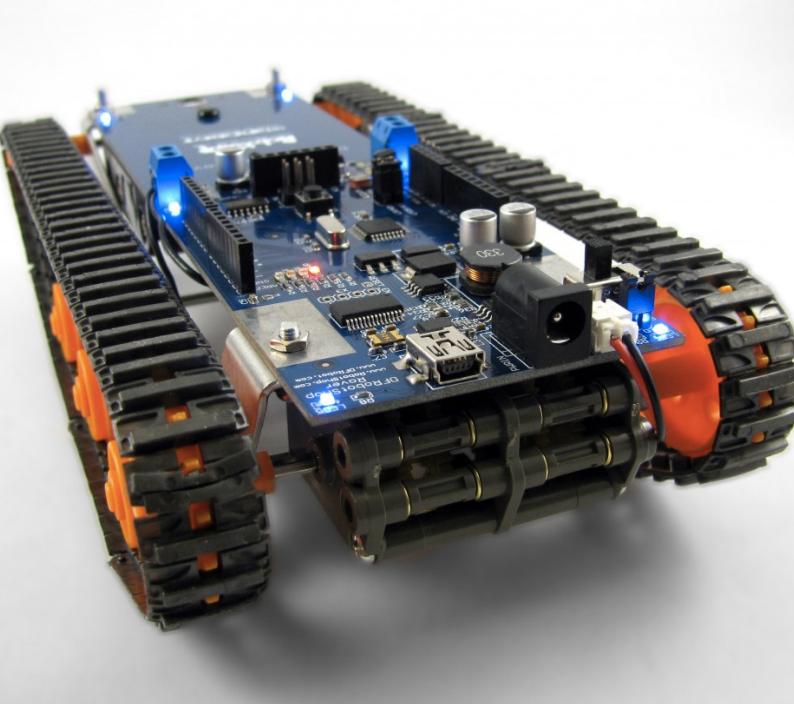
Learning Goals

- What is an Arduino?
- What is an embedded system?
- How to make an LED blink on an Arduino
- How to make an LED fade on an Arduino
- Vocab: Arduino board, bread board, male-male wires, LEDs, compiling a program, uploading a program, digital vs analog

What is an Arduino?



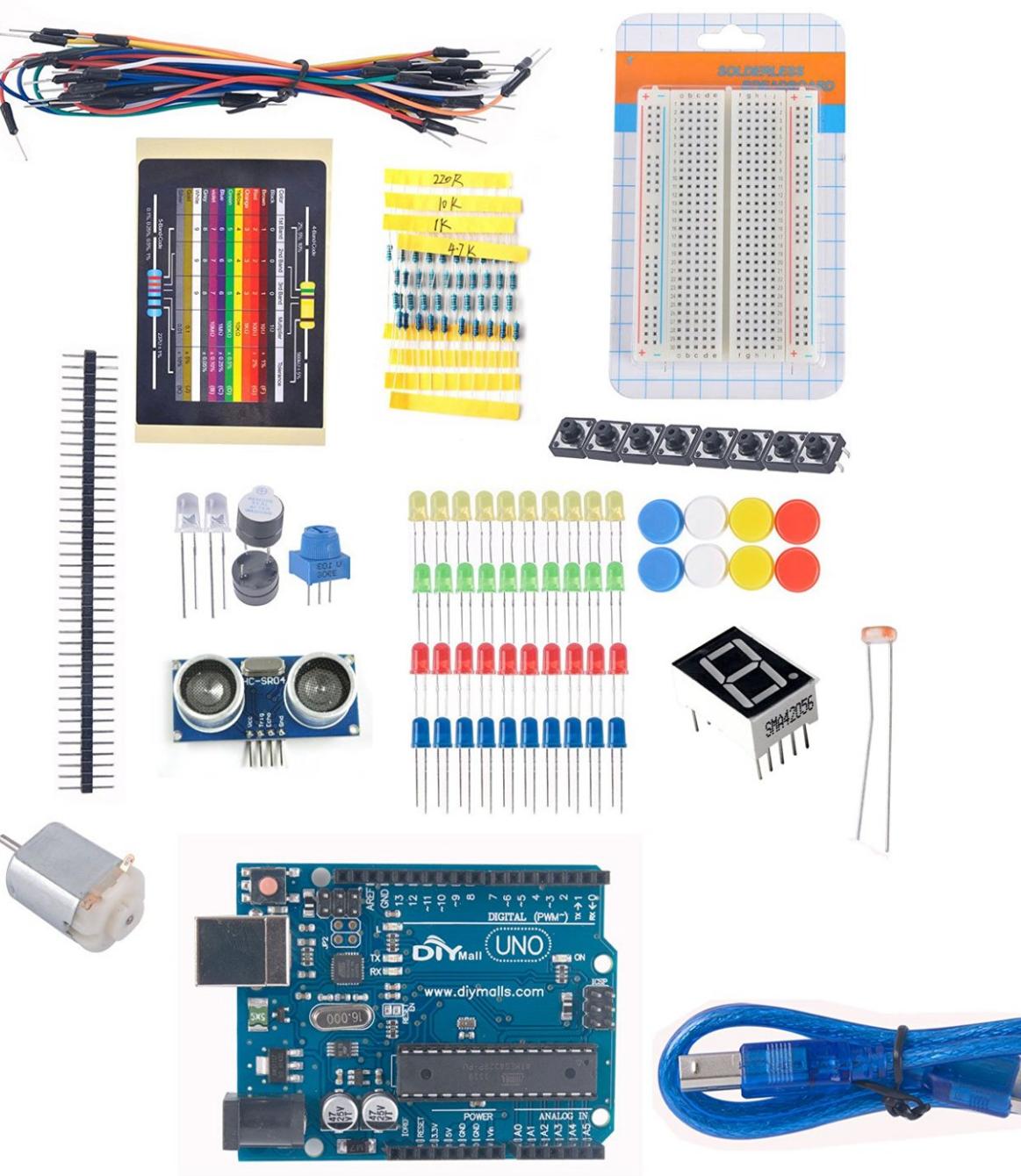
- A small computer on a single chip
 - containing a processor, memory, and input/output
- Typically "embedded" inside some device that it controls
- Small and low cost





What is an Embedded System?

- An **embedded system** is a computer **system** with a dedicated function within a larger mechanical or electrical **system**, often with real-time computing constraints.
- It is **embedded** as part of a complete device often including hardware and mechanical parts.
- **Embedded systems** control many devices in common use today.



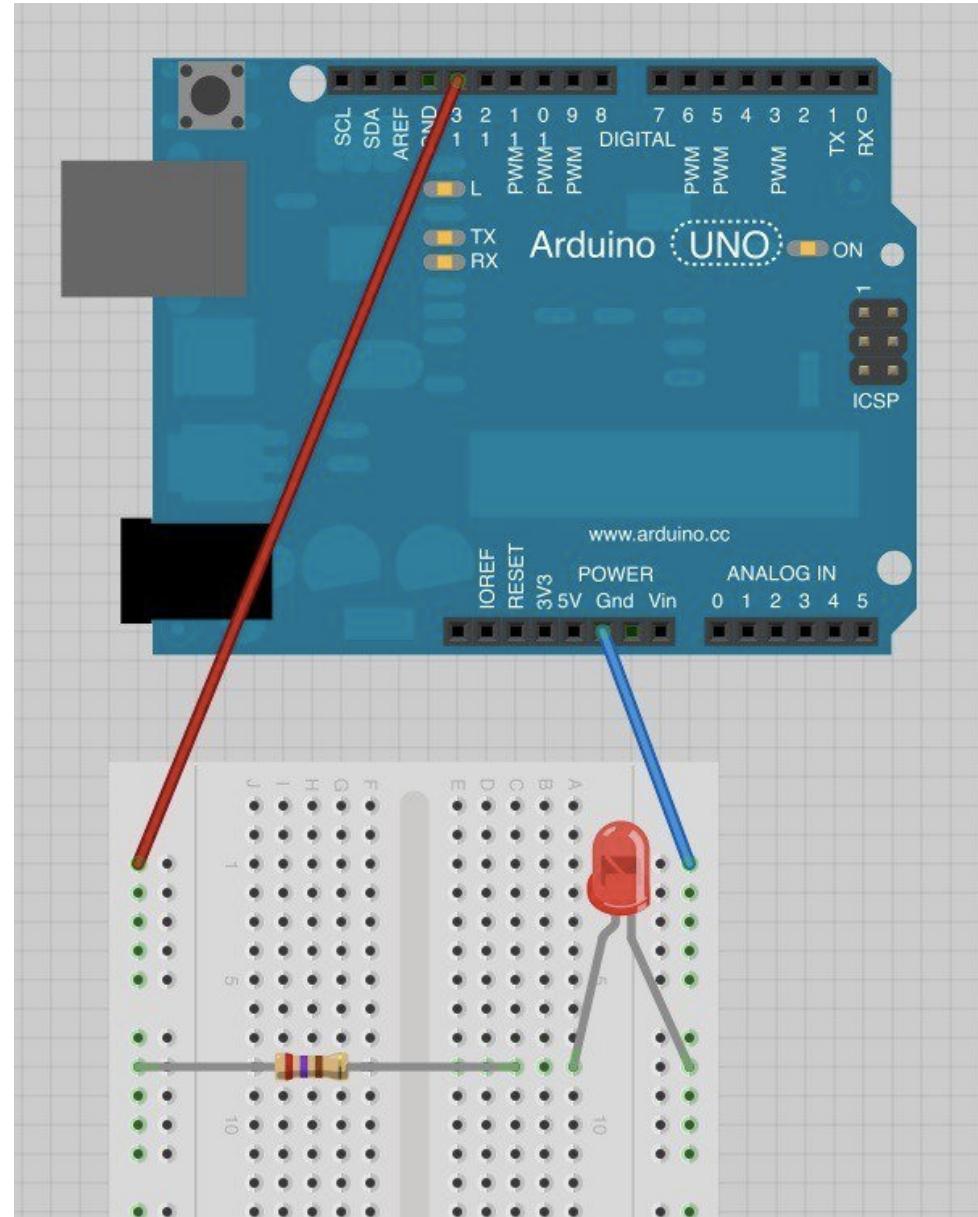
Get your own

- **Hardware ~ around \$20**
 - Diymall UNO R3 Beginner Learning Kit for Arduino Starter Kits LED Set Xmas Gift Experiment by *DIYmall*
 - <https://amzn.com/B017SCDJ64>
- **Software ~ free**
 - Download at arduino.cc

Blink Example

Example: Blink

- Hardware
 - Arduino board
 - Bread board
 - 2 male-male wires (color doesn't matter)
 - 1 LED (color doesn't matter)
- Software
 - Launch the Arduino IDE
 - Select your board
 - Select your serial port (don't forget this!)
 - Open the example Basics → Blink
 - Upload the program



Play with the Code

1. What does **digitalWrite** do? **delay**?
2. What happens if you put **//** (forward slash, forward slash) in front of a line of code?
3. What happens if you change **pinMode(LED_BUILTIN, OUTPUT)** to say **pinMode(13,OUTPUT)**? What about **pinMode(9,OUTPUT)**?
4. Can you make the LED blink using pin 9?

Challenges

- Make your program light up multiple LEDs at the same time.
- Make your program light up multiple LEDs at different times.
- Make your program light up to the tune of “Jingle Bells”

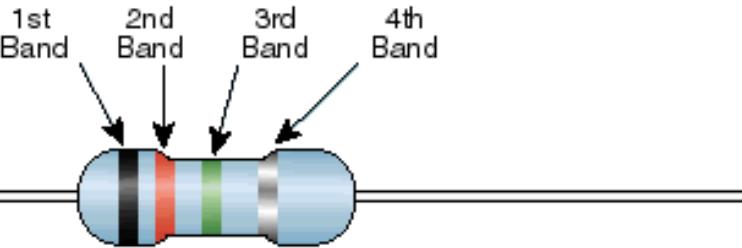
Resistors

Learn how to change the brightness of an LED by using different values of resistor.

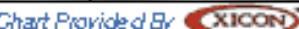
<https://learn.adafruit.com/adafruit-arduino-lesson-2-leds/overview>

Resistor Color Code

Standard EIA Color Code Table 4 Band: $\pm 2\%$, $\pm 5\%$, and $\pm 10\%$



Color	1st Band (1st figure)	2nd Band (2nd figure)	3rd Band (multiplier)	4th Band (tolerance)
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	$\pm 2\%$
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold			10^{-1}	$\pm 5\%$
Silver			10^{-2}	$\pm 10\%$

Chart Provided By 

- The resistor color code works like this, for resistors like this with three colored stripes and then a gold stripe at one end.

Each color has a number, as follows:

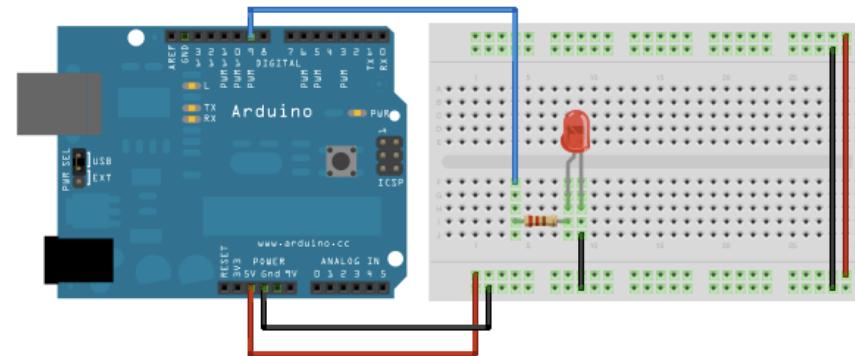
- Black 0
- Brown 1
- Red 2
- Orange 3
- Yellow 4
- Green 5
- Blue 6
- Purple 7
- Gray 8
- White 9

- The first two stripes are the first two digits of the value. The next stripe is the number of zeros that need to come after the first two digits.
 - A resistor with stripes brown, black, orange is 10 and three zeros so $10,000 \Omega$ in other words $10 \text{ k}\Omega$.

Fade Example

Example: Fade

- Hardware
 - Use the same hardware setup as the Blink example
- Software
 - Open the example Basics → Fade
 - Upload the program



Play with the Code

1. What happens if you try to use pin 13 instead of 9? Test out other pins. Which work and which don't?
2. What does changing the **fadeAmount** do? (Try 1, 10, 25, 255) Why?

Try this out:

- Open Tools → Serial Monitor
 - Add **Serial.begin(9600)** to the end of the **setup()**
 - Add **Serial.println(brightness)** at the top of the **loop()**
 - Load the program and observe what happens
3. What does **if (brightness <= 0 || brightness >= 255)** do?
 4. What does **fadeAmount = -fadeAmount;** do?

Challenge

- Make the LED fade out very slowly and then not come back on.