



INCREDIBLE WEARABLES FOR FIVE OR MORE KITS

Time Needed: approximately 60 minutes depending on the number of THINGs you have.

Tip:

This is a great exercise for older youth (13+) to learn more about how computers and microprocessors work and the process it takes to update the firmware for hardware devices like, The THING.

Event Planning:

If there are more than 15 THINGs being used in the same space there must be at least 75 feet between each cluster of 15 to prevent interference.

Materials Needed:

USB to USB-B micro cable (this is a common cable for Android phone chargers), Computer, fine tip permanent marker and all of your THINGs from the Incredible Wearables Kit.



How it works:

Each THING has come programmed with the same firmware. The firmware is a set of instructions programmed on a hardware device, in this case, The THING. The firmware allows the THING to know what to do and how to interpret the information it is getting from different sensors. The firmware on The THING currently allows you to operate 1-4 THINGs at the same time, however to have more than that work at the same place at the same time you must change each THINGs firmware so that it has a unique SSID (network name).

The instructions in this guide walk you through the steps to make a simple edit to each THINGs code. So that each one will have an assigned SSID. These edits will be done by downloading the firmware file from 4-h.org/NYSD and then editing the firmware using a software program called Arduino. Arduino is a text editor that allows you to make changes to your THINGs programming. This system is very similar to making changes to a word document. You can type in text and delete items that you don't need anymore or would like to edit.

Let's get started!

- Part I:** Installing Arduino
- Part II:** Updating Board Files in Arduino
- Part III:** Downloading The THING's Firmware
- Part IV:** Updating The THING's Firmware

Learn more online at: www.4-H.org



#4HNYSD

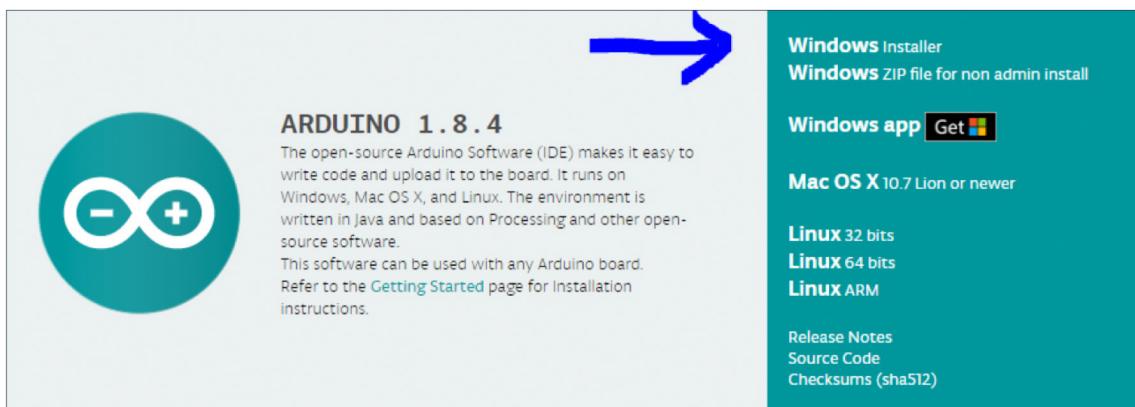


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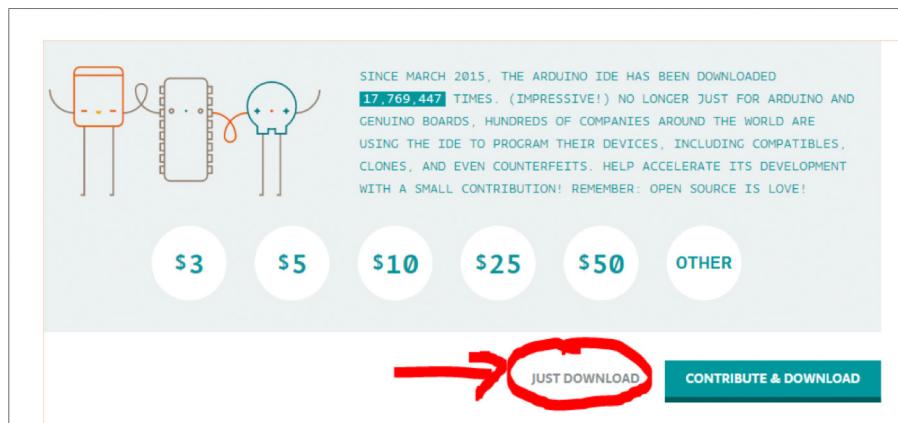
PART I - INSTALLING ARDUINO

Arduino is a text editor that allows you to program your THING. In **Part I** you will be downloading and installing Arduino in order to change the SSID(network names) on each of your THINGS.

1. Go to <https://www.arduino.cc/en/Main/Software>. On the right hand side of the window is a turquoise box that lists different operating systems. Select the operating system that your computer runs.



2. At the bottom of the page select “Just Download” to the left of the turquoise button.



Learn more online at: www.4-H.org

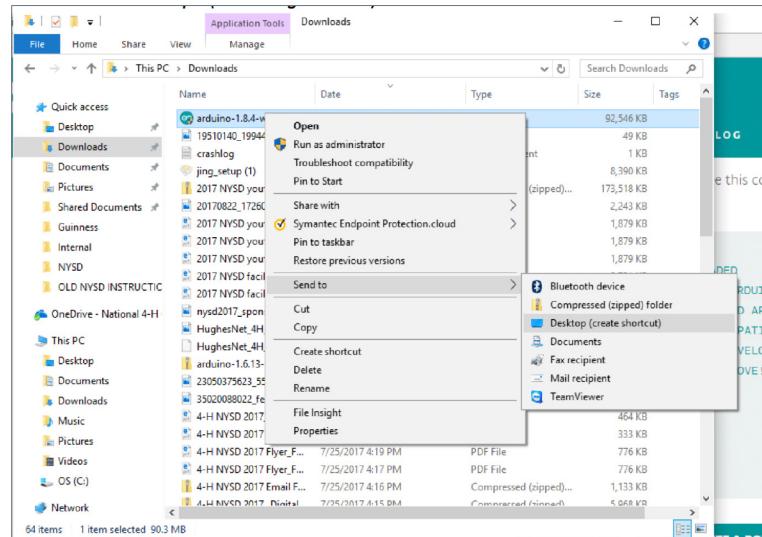


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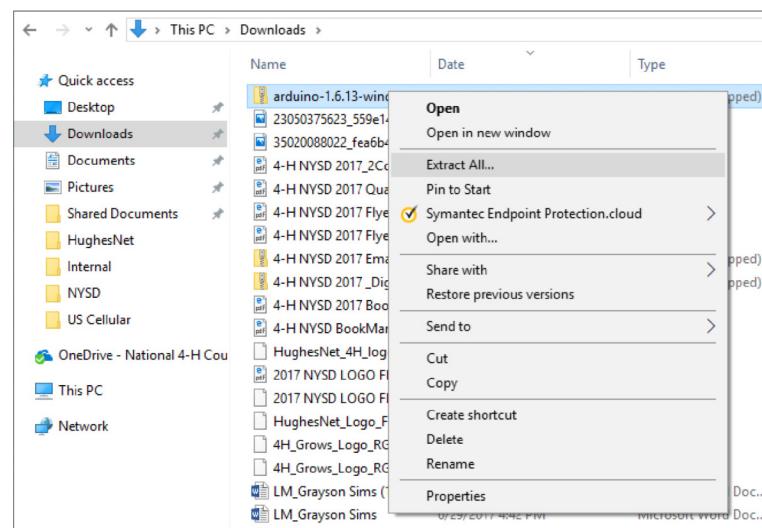
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3. Open your computer's "downloads" folder and move the newly downloaded file "Arduino-1.8.4" to your desktop so you can easily find it.

Tip: For Windows computers you can right click on "Arduino-1.8.4" and select "Send To" and then select "desktop" (see image below)



4. If you downloaded the zipped version of Arduino you need to follow this step. If not, move on to Part II. Select the file "Arduino-1.8.4" and click "Extract All". This will unzip all of the files in the folder.



NOTE:
You will also need to install FTDI drivers on your computer. You can do that by following the instructions on Sparkfun's website, here:

<https://learn.sparkfun.com/tutorials/how-to-install-ftdi-drivers/all>

Learn more online at: www.4-H.org



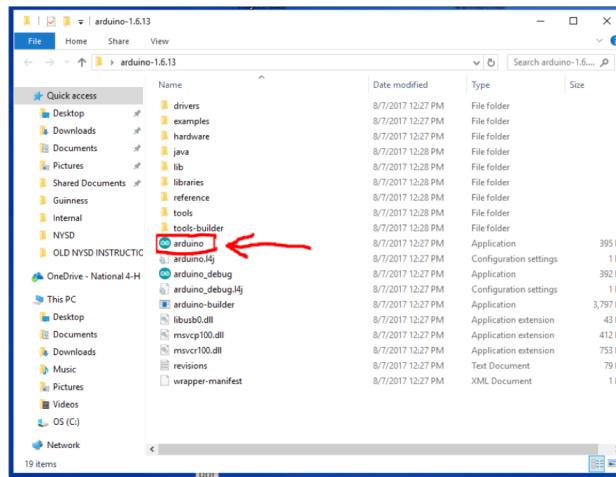
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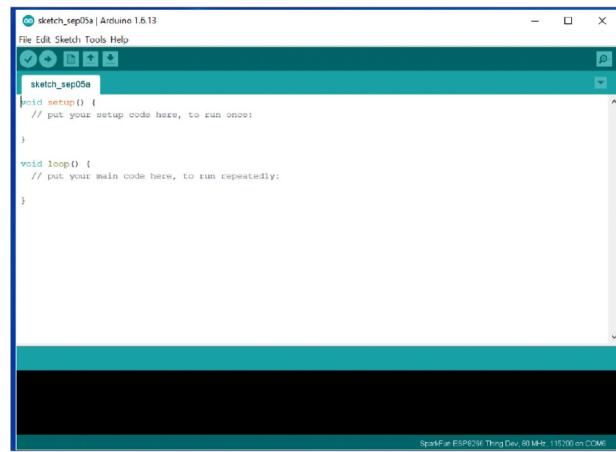
PART II - INSTALLING BOARD FILES INTO ARDUINO

Arduino can be used to program a huge variety of hardware in order for it to do this it must know what device you have connected, it does this using "Board files". The "board files" are a set of special instructions that Arduino uses to communicate with the THING.

1. Go to your Desktop where you just saved Arduino. Click on the file and select the file that has the turquoise logo and is labeled "Arduino".



2. A window will open that looks like the below image.



Learn more online at: www.4-H.org

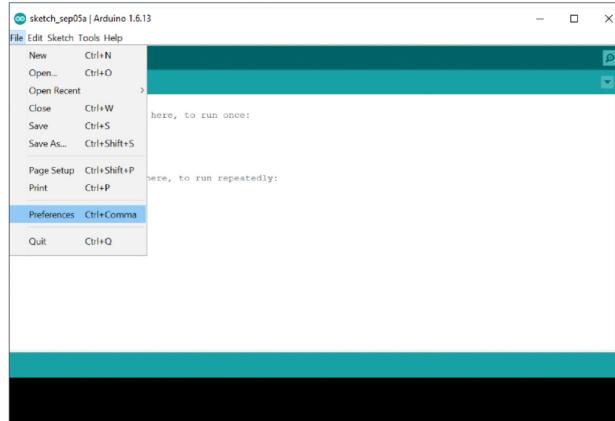


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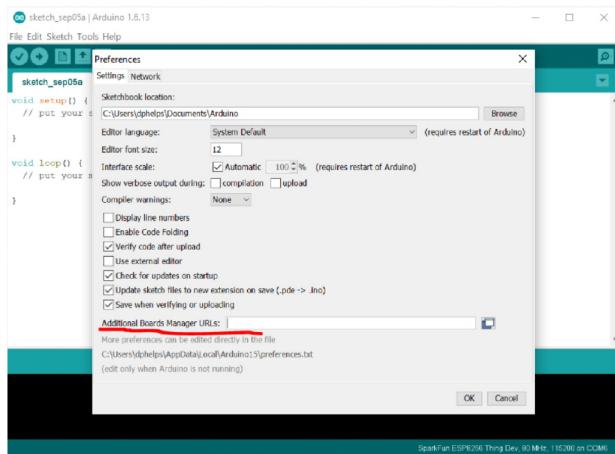


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- 3.** Click on "File" (This is labeled "Arduino" on Mac") at the top left of the Arduino menu bar. Then Select "Preferences".



- 4.** Towards the bottom of the Preferences Menu There is a section titled "Additional Board Manager URLs:" Click in the white box and paste in this url: http://arduino.esp8266.com/stable/package_esp8266com_index.json



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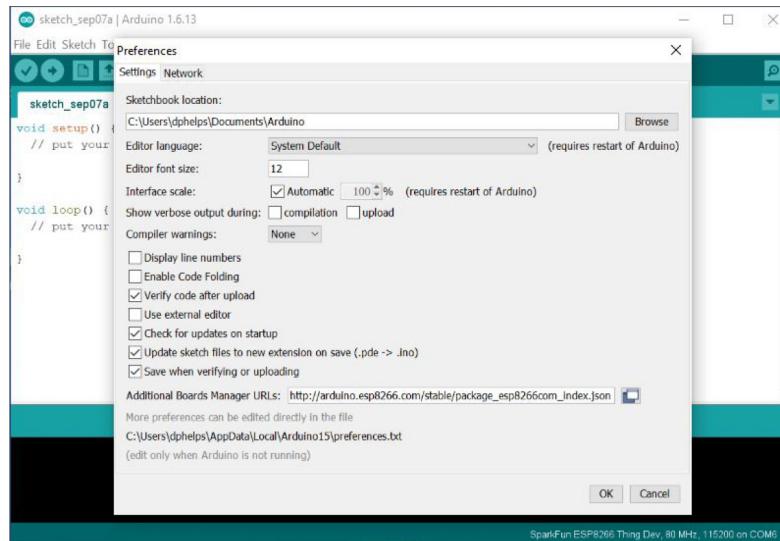


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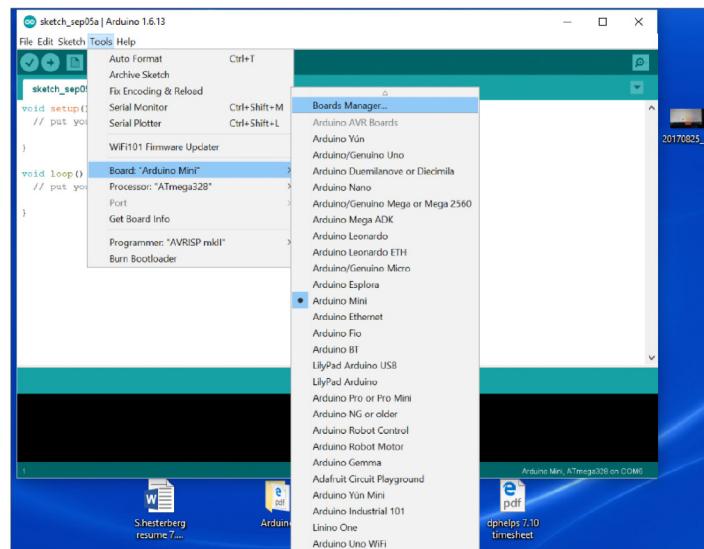


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- 5.** In the preferences pop-up, you will also see a list of checkboxes along the left hand side. Make sure that the boxes displayed in the image below are all checked (On a Mac there will also be a checkbox for “Aggressively cache” that should be checked). Then select “Ok” at the bottom of the box.



- 6.** Now go to your top menu bar again and select Tools. Scroll down to where it says “Board:” The name next to board will vary depending on the default that your computer selected; You can ignore this name. At the top of the dropdown list select “Boards Manager...”



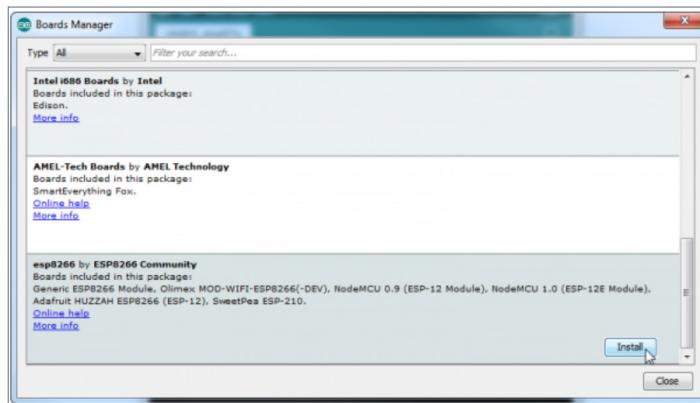
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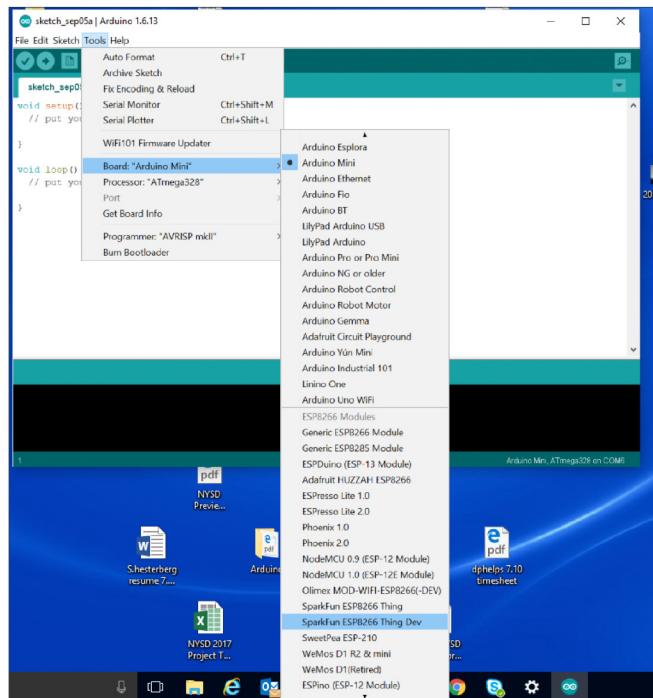
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- Once you are in the Boards Manager, scroll down until you see the title “esp8266 by ESP8266 Community”. Click on the install button.



- Now you will go back to tools and select “Board:” again. This time on the drop down menu at the very bottom is a section called “ESP8266 Modules”. In this section you will click on the item named “Sparkfun ESP8266 Thing Dev”.



NOTE:

If educators have a previous version of arduino already installed that has an older version of the esp8266 board definitions, this can cause the IDE to fail reading the board as a valid device to upload to. This can be solved by going into the user\appdata\arduino\packages folder and deleting their ESP8266 folder, then installing the new one.

Learn more online at: www.4-H.org



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PART III - DOWNLOADING THE THING'S FIRMWARE

In this step you will be downloading the 4-H NYSD Firmware file from the NYSD webpage.

1. Go to the website <http://4-h.org/parents/national-youth-science-day/#!guides-resources>
2. In the Guides and Resources Section you will click on the drop down menu titled “Incredible Wearables for More than Four Groups”.
3. Download the file “4H_NYSD_Firmware”
4. Save “Firmware for The THING” to your desktop.

NOTE: The menu is titled “Incredible Wearables for Five or More Kits”.

PART IV - UPDATING THE THING'S FIRMWARE

In this section you will be changing one line of the Firmware's code for each of your THINGS.

1. Click on the file “Firmware for The THING” on your desktop. This will open the file in Arduino and you will see text on the page in front of you. The tab at the top of the sheet should read “4H_NYSD_firmware”. (While opening the file, you may get a notice to create a folder and move the file. If this happens select ok. See image 2 below)

```

4H_NYSD_Firmware | Arduino 1.8.4 (Windows Store 1.8.8.0)
File Edit Sketch Tools Help
4H_NYSD_Firmware
1
2 //include <SoftwareSerial.h>
3
4 /*
5 Optical Heart Rate Detection (TBA Algorithm) using the MAX30105 Breakout
6 By: Nathan Seidle # sparkFun Electronics
7 Date: October 2nd, 2014
8 https://github.com/sparkfun/MAX30105_Breakout
9
10 This is a demo to show the reading of heart rate or beats per minute (BPM) using
11 a Peripheral Beat Amplitude (TBA) algorithm.
12
13 It is best to attach the sensor to your finger using a rubber band or other tightening
14 device. Humans are generally bad at applying constant pressure to a thing. When you
15 press your finger against the sensor it varies enough to cause the blood in your
16 finger to flow differently which causes the sensor readings to go wonky.
17
18 Hardware Connections (Breakoutboard to Arduino):
19 -5V = 5V (3.3V is allowed)
20 -GND = GND
21 -SDA = A4 (or SDA)
22 -SCL = A5 (or SCL)
23 -INT = Not connected
24
25 The MAX30105 Breakout can handle 5V or 3.3V I2C logic. We recommend powering the board with 5V
26 but it will also run at 3.3V.
27 */
28
29 #include <Wire.h>
30 #include "MAX30105.h"
31
32 #include "heartRate.h"
```

```

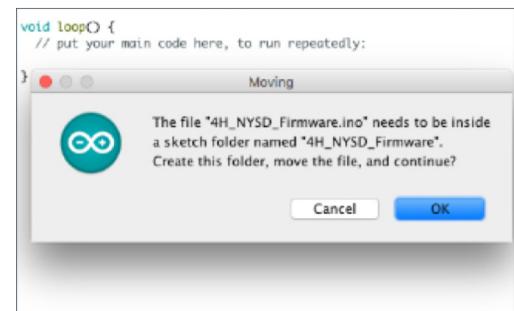


Image 2

### NOTE:

If you are unable to open the file, or are getting an error message stating something like “Could not create the sketch.”, try downloading the sketch, or copying/pasting it, from here:  
<https://github.com/SparkfunTechSupport/4H-Firmware>

The other option is to unzip the downloaded file, and then change the name so that it doesn't start with a number (which is not allowed in Arduino).

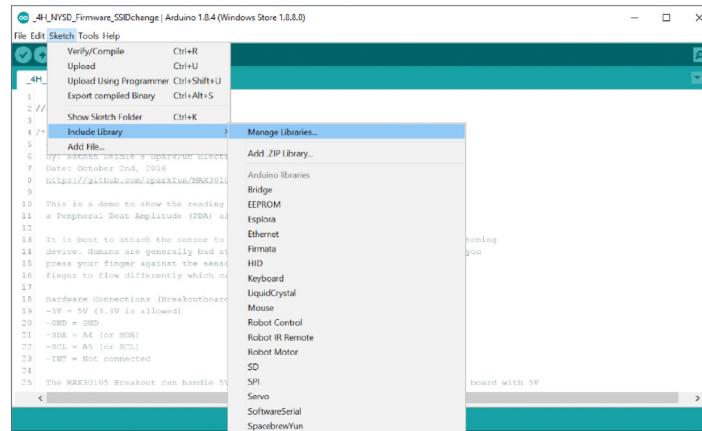
Learn more online at: [www.4-H.org](http://www.4-H.org)



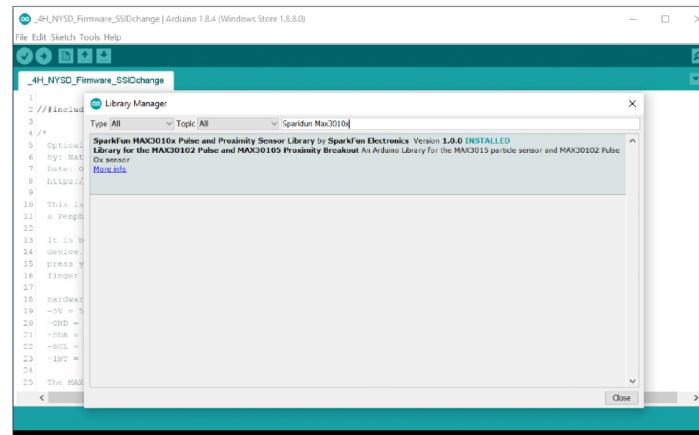
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- In the top menu bar click on the “Sketch” and then click on “Manage Libraries”.



- A pop-up box will open. In the top search bar type in “Sparkfun Max3010x”. Find the box titled “Sparkfun Max3010x Pulse and Proximity Sensor Library”. In the bottom, right of the box you will click on the “Install” button. Once it is complete you will see a turquoise lettering at the top that says “INSTALLED”. Now close out of the “Library Manager”



- Connect your first THING to the computer using a USB to USB-B micro cord (image shown at beginning of guide).

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5. Go to your menu bar at the top of the page and select “Tools”. Click on “Port” and then select whichever port is available. \*The port number will change every time you plug in a new device. If there is more than one port listed remove all other USB connections to your computer and then try it again. Select whichever port is available.

The port numbers on a MAC are presented differently. The default port named “Bluetooth-incoming-Port” is the default. (see image2)

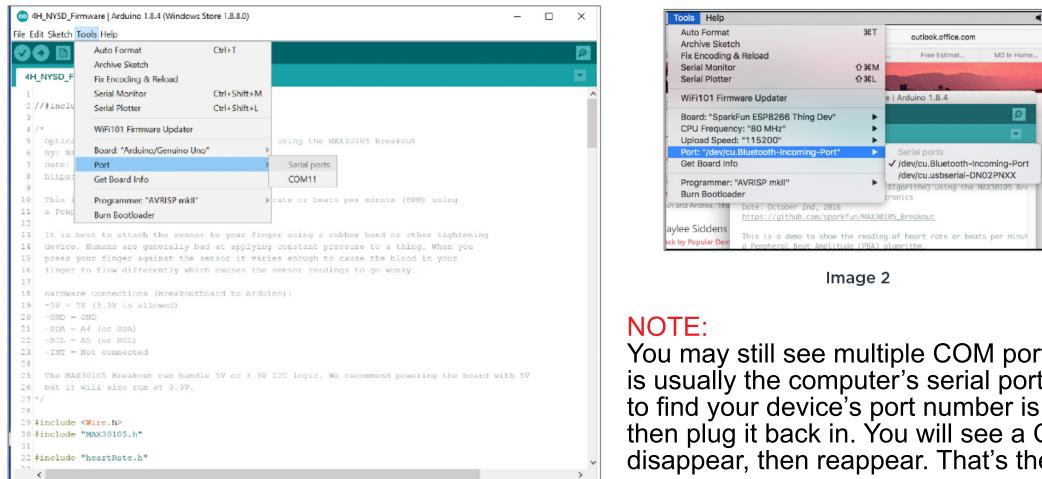
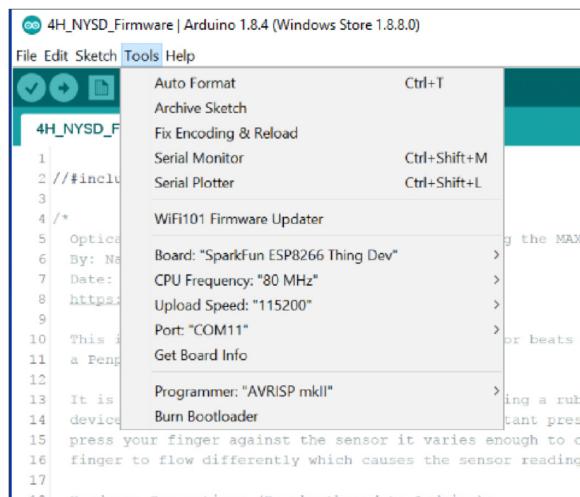


Image 2

#### NOTE:

You may still see multiple COM ports, as COM1 is usually the computer's serial port. A quick way to find your device's port number is to unplug the Thing, then plug it back in. You will see a COM port disappear, then reappear. That's the one you want.

6. If you click on “Tools” Your drop down menu should now look the same as the image below. Check that the Board says: “SparkFun ESP8266 Thing Dev” and that a Port is listed.



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# INCREDIBLE WEARABLES

7. Close out your Tools Menu and Go the main tab labeled “4H\_NYSD\_Firmware”. Use the bar at the right to scroll down to the section that says “Change SSID in next line”. This is located at approximately line number 147, thought this # will vary from computer to computer by a few lines.



```

4H_NYSD_Firmware

130 htmlText.concat("</svg>");
131 //end line code
132 htmlText.concat("
");
133 htmlText.concat("
");
134
135 htmlText.concat("</body>");
136 htmlText.concat("</html>");
137 server.send(200, "text/html" , htmlText);
138 }
139
140 void setup() {
141
142 delay(1000);
143 Serial.begin(115200);
144 pinMode(5, OUTPUT);
145 pinMode(4, INPUT_PULLUP); //pull-up for tilt Sensor
146 //***** Change SSID in next line ****
147 strcpy(ssid, "Incredible Wearables");
148 //*****
149 //heartrate code
150 Serial.println("Initializing...");
```

8. You are going to add a number at the end of where it says “Incredible Wearables”, on line 147, inside the quotation marks. This line will change the name of your connected THING’s SSID (network name). We recommend starting with 01 and then going up one number for each additional THING whose SSID you reprogram.

\*\*If you do not see line numbers, do Part II step 5 again, before proceeding\*\*



```

4H_NYSD_Firmware §

130 htmlText.concat("</svg>");
131 //end line code
132 htmlText.concat("
");
133 htmlText.concat("
");
134
135 htmlText.concat("</body>");
136 htmlText.concat("</html>");
137 server.send(200, "text/html" , htmlText);
138 }
139
140 void setup() {
141
142 delay(1000);
143 Serial.begin(115200);
144 pinMode(5, OUTPUT);
145 pinMode(4, INPUT_PULLUP); //pull-up for tilt Sensor
146 //***** Change SSID in next line ****
147 strcpy(ssid, "Incredible wearables01"); ←
148 //*****
149 //heartrate code
150 Serial.println("Initializing...");
```

151

152 // Initialize sensor

153 if (!particleSensor.begin(Wire, I2C\_SPEED\_FAST)) //Use default I2C port, 400kHz speed

154 {

155 Serial.println("MAX30105 was not found. Please check wiring/power. ");

156 while (1);

157 }

158 Serial.println("Place your index finger on the sensor with steady pressure.");

159

160 particleSensor.setup(); //Configure sensor with default settings

161 particleSensor.setPulseAmplitudeRed(0x0A); //Turn Red LED to low to indicate sensor is running

162 particleSensor.setPulseAmplitudeGreen(0x0A); //Turn Green LED to low to indicate sensor is running

163

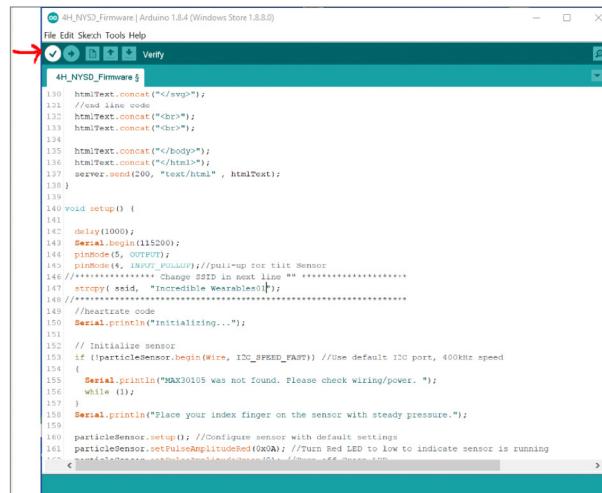
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9. Now at the top of the page you will click on the check mark. This will test to make sure there is nothing wrong with the code. If it worked you will see a notice at the bottom of the page that says "Done Compiling"

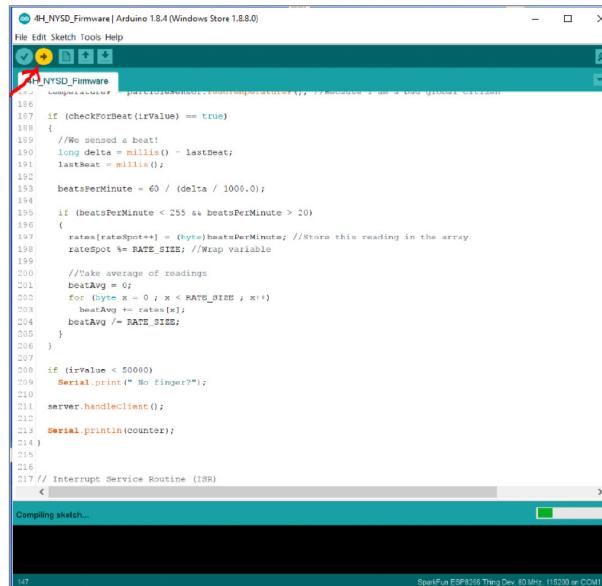


```

4H_NYSD_Firmware | Arduino 1.8.4 (Windows Store 1.8.8.0)
File Edit Sketch Tools Help
✓ Verify
4H_NYSD_Firmware §
130 htmlText.concat("</svg>");
131 //end line code
132 htmlText.concat("
");
133 htmlText.concat("<hr>");
134
135 htmlText.concat("</body>");
136 htmlText.concat("</html>");
137 server.send(200, "text/html", htmlText);
138 }
139
140 void setup() {
141 delay(1000);
142 Serial.begin(115200);
143 pinMode(5, OUTPUT);
144 pinMode(4, INPUT_PULLUP); //pull-up for tilt Sensor
145 //***** Change SSID in next line *****
146 strcpy(ssid, "Incredible Wearables01");
147 //*****
148 //hardware
149 //Serial.print("Initialzing..");
150 Serial.println("Initialzing..");
151
152 //Initialize sensor
153 if (!particleSensor.begin(WIRE, INC_SPEED_FAST)) //Use default I2C port, 400kHz speed
154 {
155 Serial.println("MAX30105 was not found. Please check wiring/power.");
156 while (1);
157 }
158 Serial.println("Place your index finger on the sensor with steady pressure.");
159
160 particleSensor.setup(); //Configure sensor with default settings
161 particleSensor.setPulseAmplitudeRef(0x0A); //Turn Red LED to low to indicate sensor is running
162

```

10. Now at the top of the page click on the arrow. This will upload the firmware to the THING. When you are finished at the bottom of the page it will say "Done uploading"



```

4H_NYSD_Firmware | Arduino 1.8.4 (Windows Store 1.8.8.0)
File Edit Sketch Tools Help
▶ Upload
4H_NYSD_Firmware §
186
187 if (checkForBeat(irValue) == true)
188 {
189 //We sensed a beat!
190 long delta = millis() - lastBeat;
191 lastBeat = millis();
192
193 beatsPerMinute = 60 / (delta / 1000.0);
194
195 if (beatsPerMinute < 255 && beatsPerMinute > 20)
196 {
197 rates[rateSpot] = (byte)beatsPerMinute; //Store this reading in the array
198 rateSpot += RATE_SIZE; //Wrap variable
199
200 //Take average of readings
201 beatAvg = 0;
202 for (byte x = 0; x < RATE_SIZE; x++)
203 beatAvg += rates[x];
204 beatAvg /= RATE_SIZE;
205 }
206 }
207
208 if (irValue < 50000)
209 Serial.print(" No finger?");
210
211 server.handleClient();
212
213 Serial.println(counter);
214 }
215
216 // Interrupt Service Routine (ISR)

```

## NOTE:

Before attempting to upload code to your Thing, be sure to slide the power switch to the ON position.

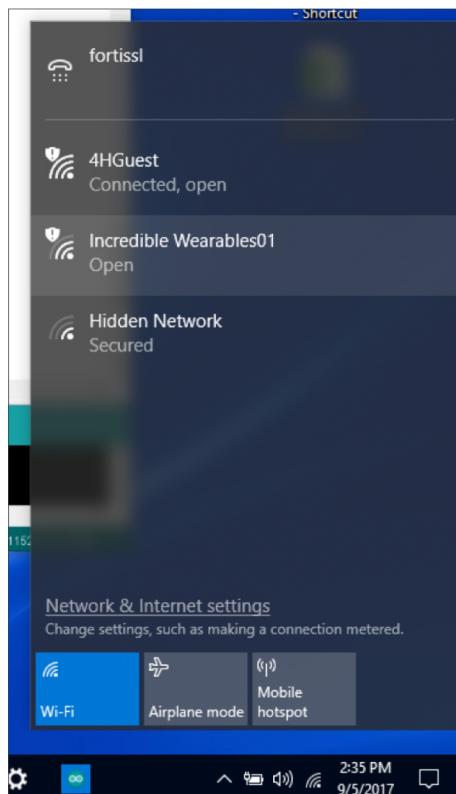
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# INCREDIBLE WEARABLES

- Unplug the THING from your computer and turn it on. Now click on your wireless networks list and check and make sure that you can see the network name that you just used.



**NOTE:**

If you are having issues connecting to your Incredible Wearable, particularly on a Chromebook or phone, make sure that you disable auto-connect to your other wifi connections. This has been seen to interfere with connecting to the Thing.

**NOTE:**

When working with Chromebooks, you may find that you are unable to connect to your Things. You may see something like "Connection Failure" or "Not In Range". What appears to be happening is when the initial connection fails, it saves that specific WiFi id as "failed" so in order to try reconnecting you need to power down, let the Chromebook cycle through and remove that WiFi network from the available list and then when you power it back up you need to manually select that network from the Chrome:settings tab and select "Connect" as it probably says Status: Failure in the network settings.

- Now write the number that you put after "Incredible Wearables" on the back of The THING in permanent marker, in this case it was "01". This way on your event day youth will know which network they should be connecting their THING to.
- Go back and complete steps 2 through 12 for each additional THING that you have. Just remember to name each one with a separate number/distinct network name

For additional questions about this process please reach out to Sparkfun Technical Assistance.  
At [https://www.sparkfun.com/technical\\_assistance](https://www.sparkfun.com/technical_assistance)

Learn more online at: [www.4-H.org](http://www.4-H.org)



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