Activity 1

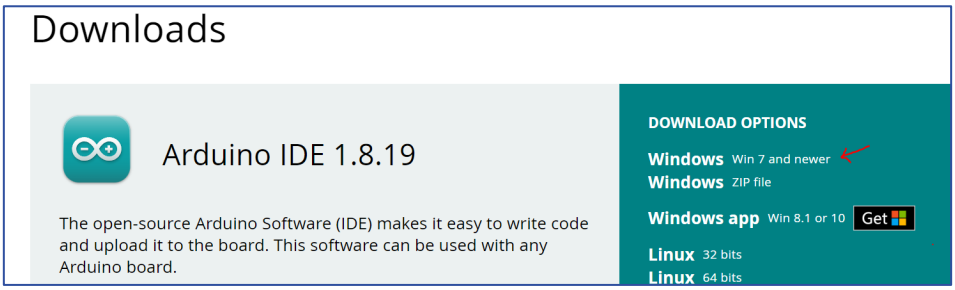
Measuring Soil Moisture

Before you start:

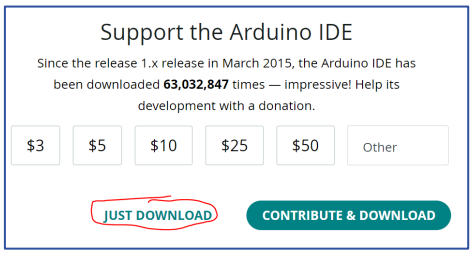
You can download starter code from this project at: https://github.com/stephbaker23/GardenMonitoring - this will make the Wi-Fi set-up in Activity 2 much easier 😊

Step 1: Download Arduino

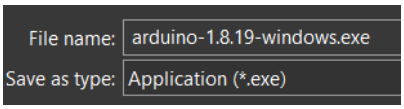
The first thing you will need to do is download the Arduino software. Go to https://www.arduino.cc/en/software and select your operating system from the 'Download Options' panel. Most people will need Windows - Win 7 and newer'.



This will take you to a page that asks for donations, but you can get it for free by clicking "Just Download":

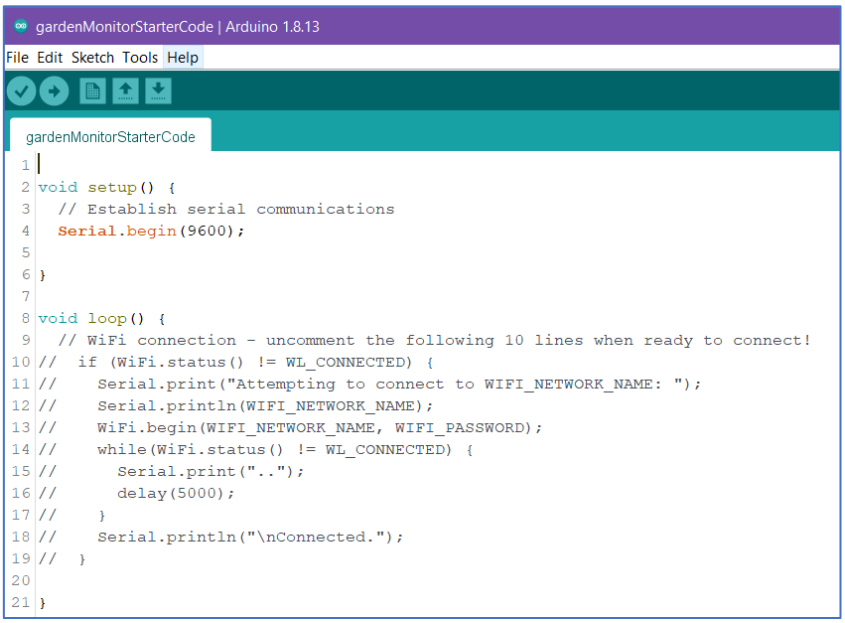


You will need to choose a place to save the installation file. Make sure you place it somewhere you can find!



Once the file has downloaded, locate it and double click on it. This will then prompt you through the Arduino installation process. If you have any questions, just ask one of your friendly instructors 😊

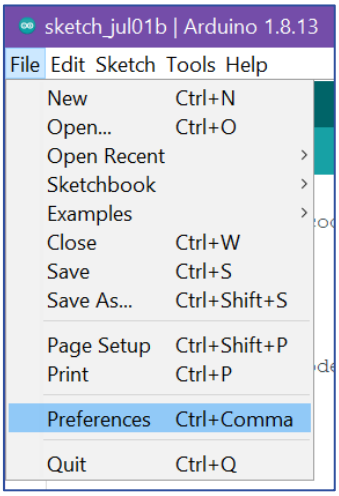
After you have Arduino installed, open the starter code that you downloaded from Github. You should see a window that looks something like the following image:



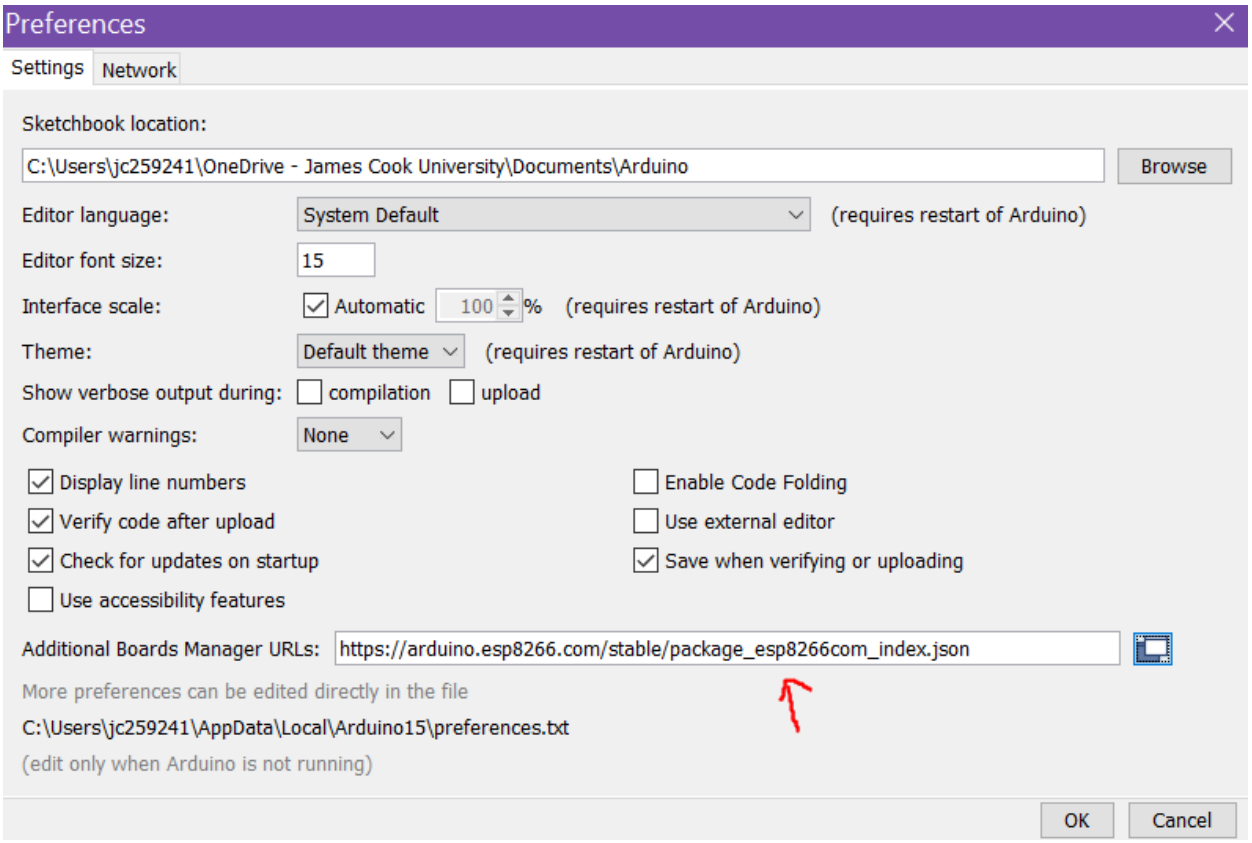
Step 2: Add the D1 Mini board to Arduino

This step is a little tricky, so follow the steps carefully. The boards we are working with today are called D1 Minis, and their microprocessor ('brains') are called ESP8266s. These aren't actually Arduino boards, so we need to add them to Arduino manually.

Firstly, go to File > Preferences in Arduino.

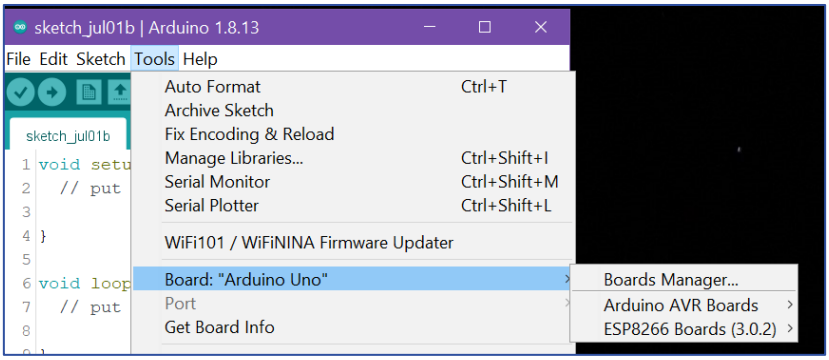


You should see the same screen as the image below. In the "Additional Board Manager URLs" section, carefully type this URL: https://arduino.esp8266.com/stable/package_esp8266com_index.json

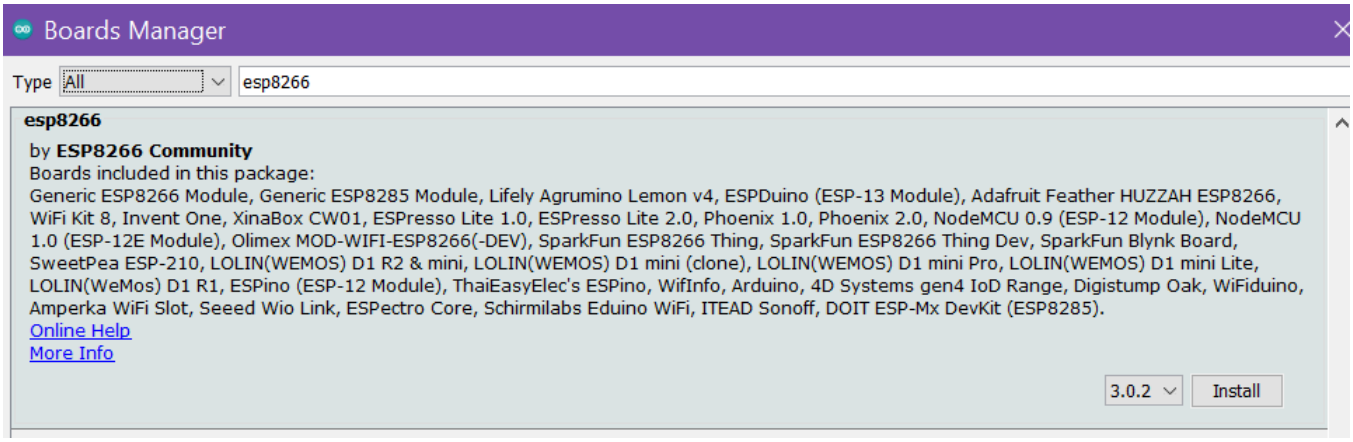


After you have typed it in (and double checked that you haven't made any mistakes!), press "OK".

Next, navigate to Tools > Board > Board Manager:

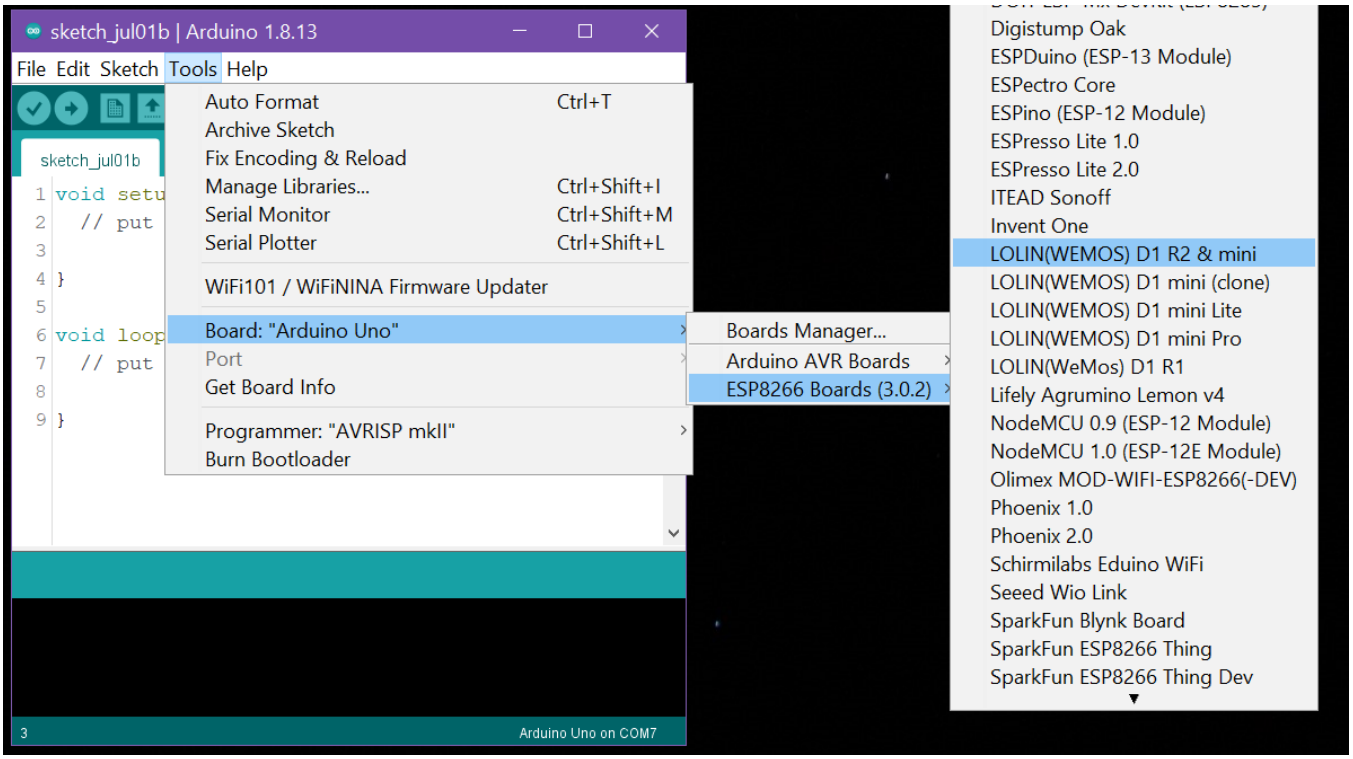


This will launch the window shown in the following image. Give it a moment to load, and then you should be able to search in the top search bar. Type in ‘esp8266’ and it will return one result, as shown below. Next, click “Install”.



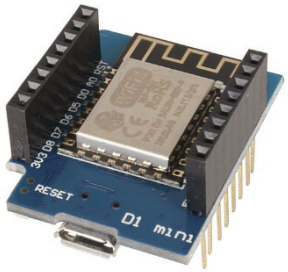
A progress bar will appear at the bottom of the window, and it will take a few seconds to install. Once the installation is complete, you can press “close” on the Board Manager window.

Now, you can select your board from the list of boards. Navigate to Tools > Boards > ESP8266 Boards and find the option that says **LOLIN (WEMOS) D1 R2 & mini**. Click on this option.

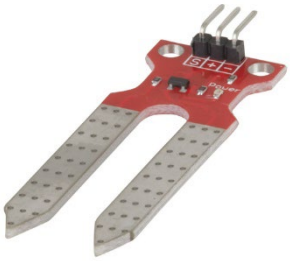


Step 3: Assemble your soil sensor

Now it's time to build some hardware! For this step, you need the following components:



D1 mini



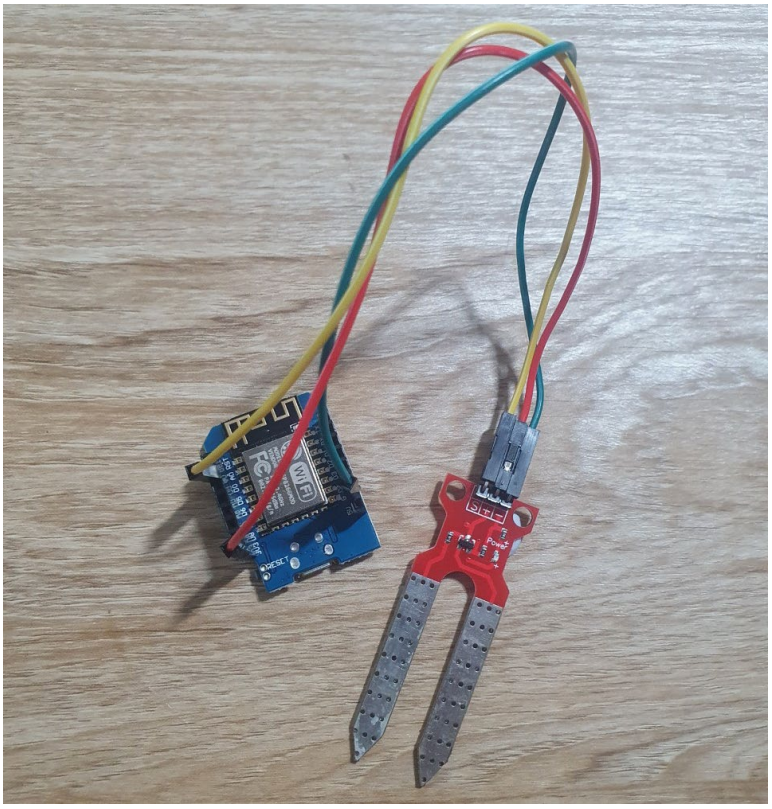
Soil moisture sensor

Micro USB cable

Female/male jumper wires (wires on one end, sockets on the other)

The soil moisture sensor has 3 pins, labelled "S" for signal, "+" for voltage supply, and "-" for ground (which is a reference voltage that the soil moisture measurements will be based on). Using your jumper wires, connect:

- "S" on the soil moisture sensor to "A0" on the D1 mini
- "+" on the soil moisture sensor to "3V3" on the D1 mini
- "-" on the soil moisture sensor to "G" (or "GND") on the D1 mini



Now connect your micro USB cable between the D1 mini and your computer – it's time to write some code!

Step 4: Read data from the soil moisture sensor

Open a blank Arduino project (if you don't already have one open). The first thing we need to do is tell the D1 mini which pin the soil moisture sensor is connected to (remember that we connected the signal to A0!). To do this, write the following code at the very top.

```
1 #define soilPin A0
```

Note that the "1" is not part of the code – it's just a line number to help you see where your code should go. You can show line numbers in your own Arduino program by going to File > Preferences and checking on "Display line number".

Next, we will want to create an empty **variable** (like a container) to store the soil moisture values into once we start reading data. Add the following line of code:

```
2 float soilValue = 0;
```

The word "float" refers to the fact that soilValue will be a decimal number.

Now, go to the "setup" block. This block will run once when the D1 mini is first connected to power. In here, we want to add the line of code `Serial.begin(9600)`. This code will allow us to display messages later on so that we can check that our soil moisture sensor is working.

```
4 void setup() {
5   // put your setup code here, to run once:
6   Serial.begin(9600);
7 }
```

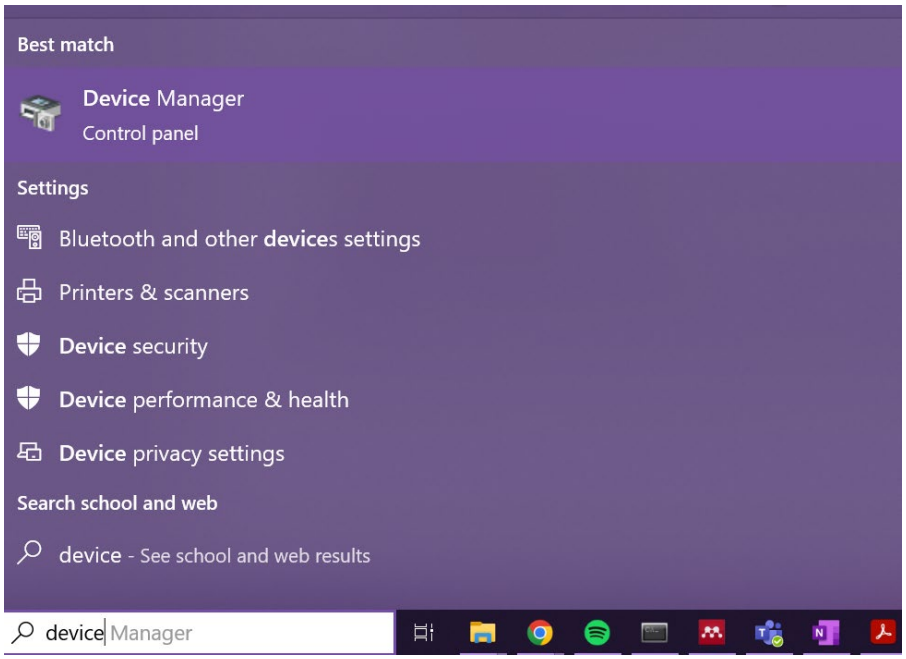
Next, go to the "loop" block. This block of code will run again and again and again, until power is disconnected from the D1 mini. Here is where we want to read the soil moisture data. Consider the following code:

```
 9 void loop() {
10   // put your main code here, to run repeatedly:
11   soilValue = analogRead(soilPin);
12   Serial.println(soilValue);
13   delay(5000);
14 }
```

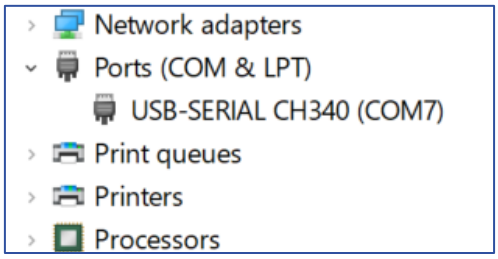
In this code,

- `soilValue = analogRead(soilPin)` -> reads the moisture value from the soil pin A0. We use 'analog' read specifically because the soil moisture sensor is analog – meaning that it gives a fluctuating voltage output rather than a numerical output. However, our D1 minis convert this voltage into a number that can be used for further analysis.
- `Serial.println(soilValue);` -> displays the most recent soil value in the Serial Monitor (we'll get to that soon) so that we can check that it's working
- `delay(5000);` -> pauses the program for 5000ms (5 seconds) – if we didn't do this, then it would be reading thousands of times per second, and soil moisture doesn't change that fast!

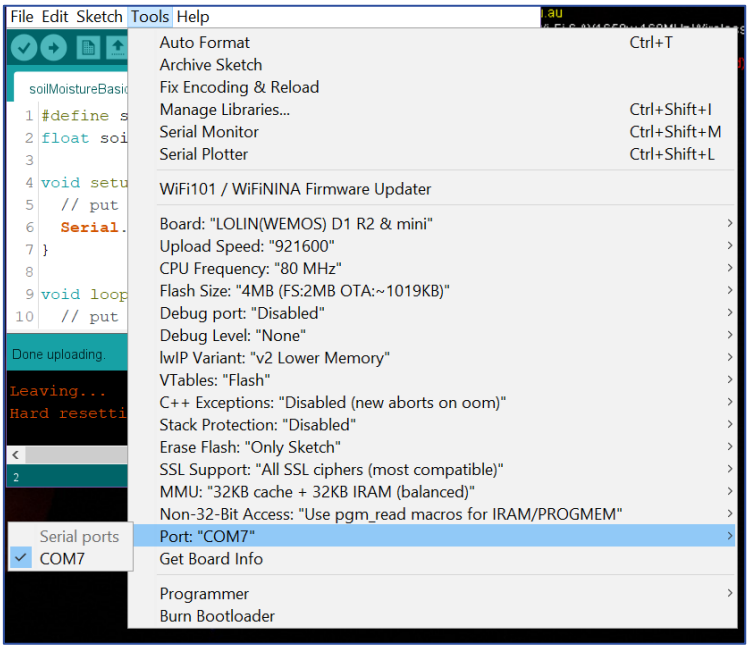
Now we are ready to upload your code to your D1 mini. To do this, we first need to check the name of the USB port your D1 mini is connected to. Go to your Windows start menu and search for “Device Manager”. Click on it to open it up.



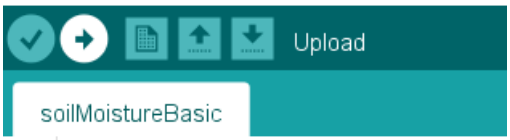
You should see an option for “Ports”. Expand this option and you will see a device with the name “USB-Serial CH340 or similar. Next to the device name is a COM port number, which is the name of your USB port – in this example, the USB port is named “COM7”.



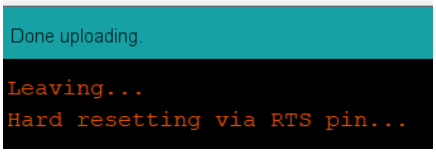
Back in your Arduino software, you will need to check whether the correct COM port is selected. Go to Tools > Port and select the port with the same name that you found in Device Manager.



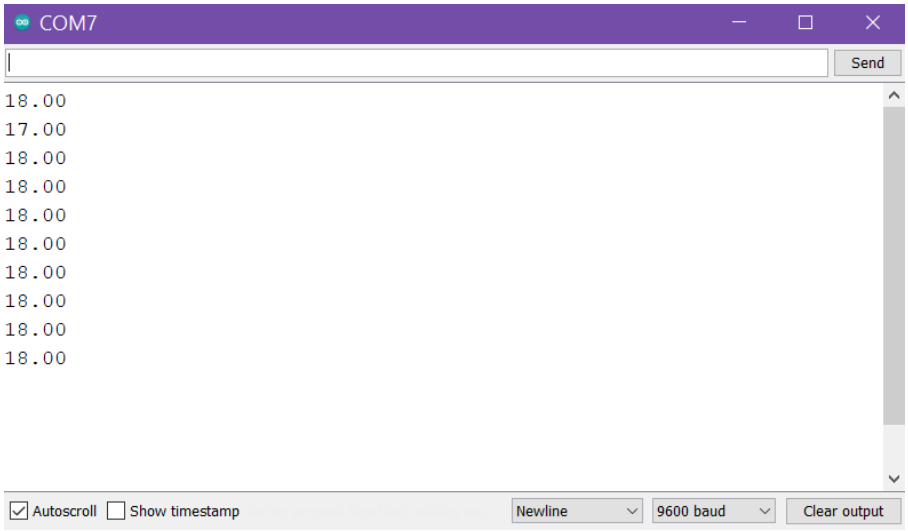
You're ready to go! Click "Upload". This will prompt you to save your file, so save it in a location that you'll remember. Then it will begin uploading to your D1 mini.



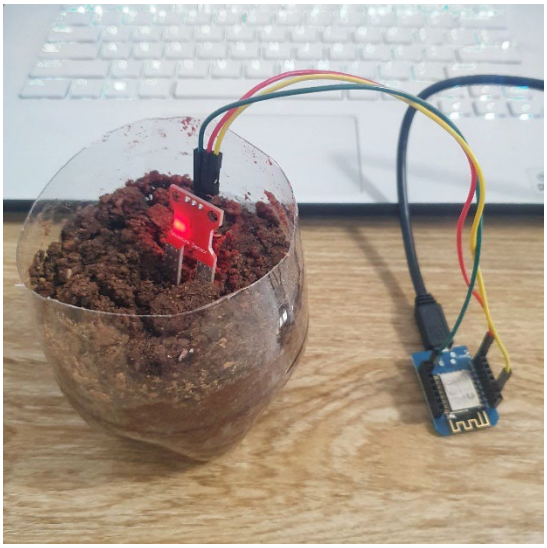
When the upload is finished, you'll see a "Done uploading" message down the bottom of the Arduino screen:



Now we can see whether this thing is working! Go to Tools > Serial Monitor. Check that the bottom corner says "9600 Baud" (and change it to 9600 if needed), as this is the communication speed that we configured in the "setup" block. Within a few seconds, you should start to see data streaming in:



How do we know that it's working? Well, try sticking it in some soil and slowly adding water! You should see the numbers change as the soil becomes more and more damp. Take note of the numbers that the D1 mini reads when the soil is dry, lightly damp, damp, and soaking wet!



Congratulations! You're now ready to start streaming the soil moisture data to the internet. Move on to Activity 2 when you're ready.