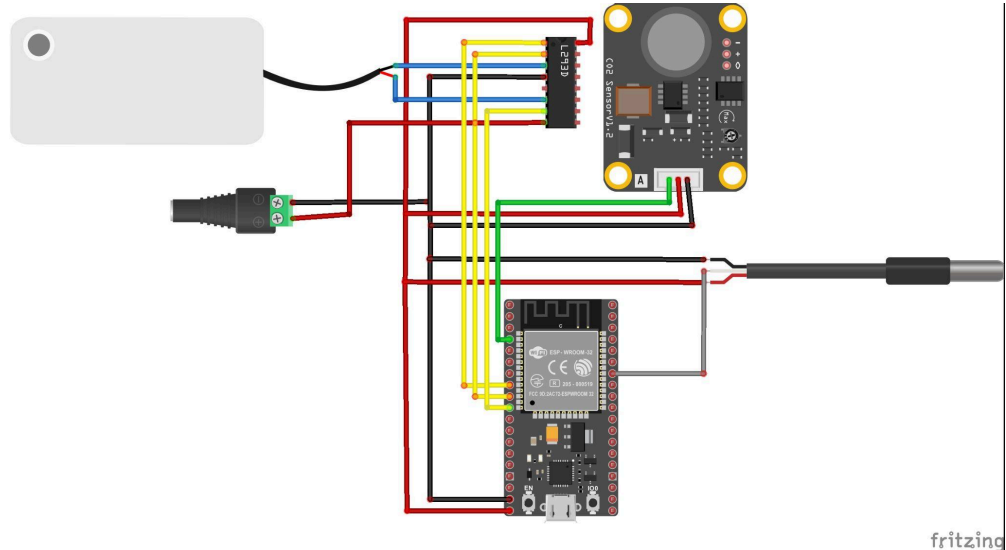


Link to these instructions in Google Docs:

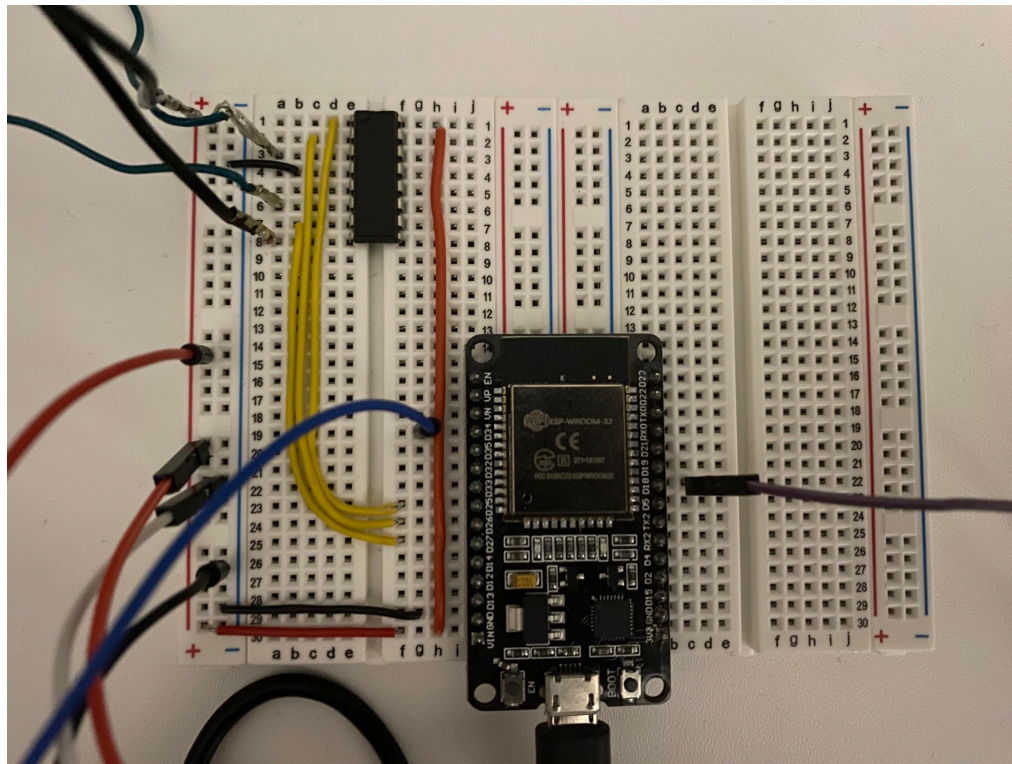
[https://docs.google.com/document/d/1eFGHNYcCwDcwbPrd09a7AQx\\_5VXZiTRYb7Jq9ZDG/CpA/edit?usp=sharing](https://docs.google.com/document/d/1eFGHNYcCwDcwbPrd09a7AQx_5VXZiTRYb7Jq9ZDG/CpA/edit?usp=sharing)

## Instructions

1. Connect all the circuitry as shown below.



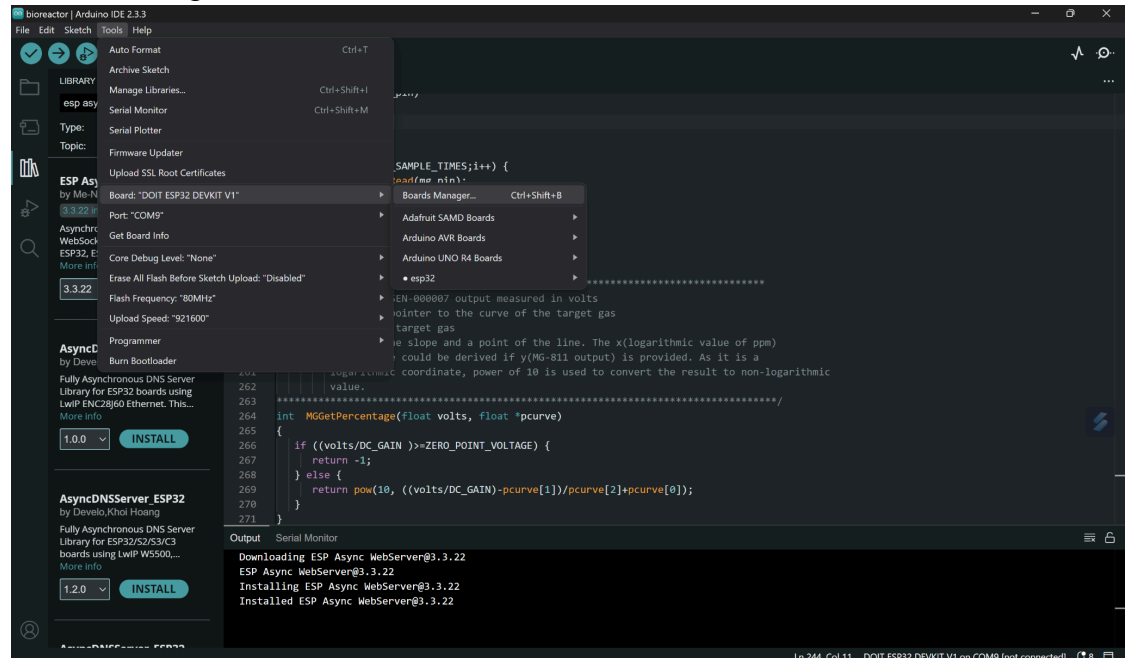
a.



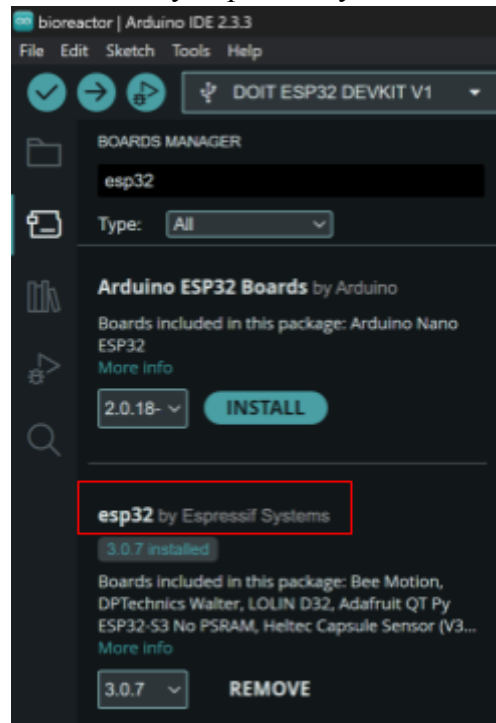
b.

2. Leave the ESP32 plugged into a power source for at least 48 hours to warm up the CO<sub>2</sub> sensor.
3. Install the Arduino IDE.

- a. <https://www.arduino.cc/en/software>
4. Open bioreactor.ino in the Arduino IDE.
5. Go to the board manager.

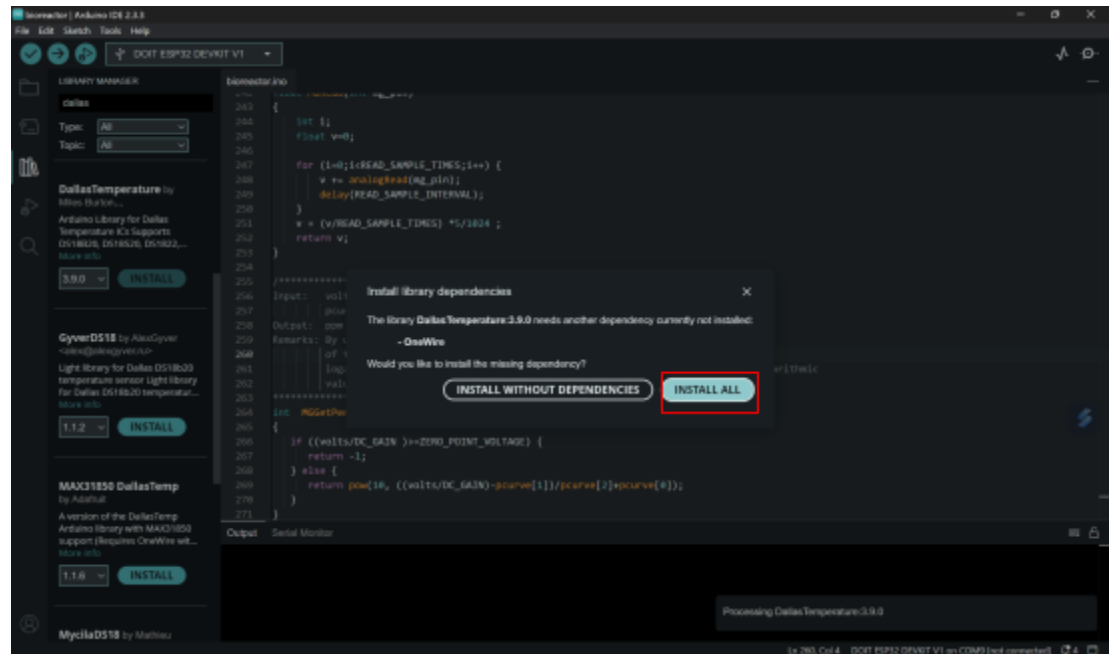


- a.
6. Install the “ESP32 by Espressif Systems” board in the Arduino IDE.



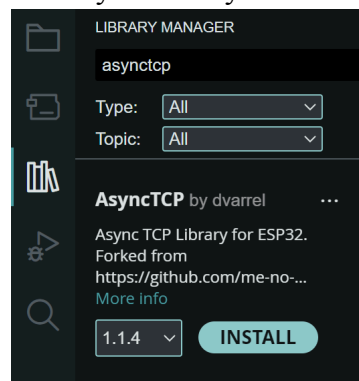
- a.
- b. *Note:* For more information:  
<https://randomnerdtutorials.com/installing-the-esp32-board-in-arduino-ide-windows-instructions/>

7. Install the “DallasTemperature by Miles Burton” library, choosing “Install All” when prompted.



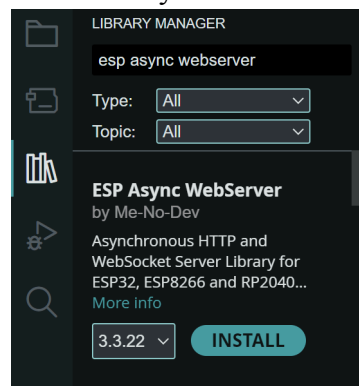
a.

8. Install the “AsyncTCP by dvarrel” library.



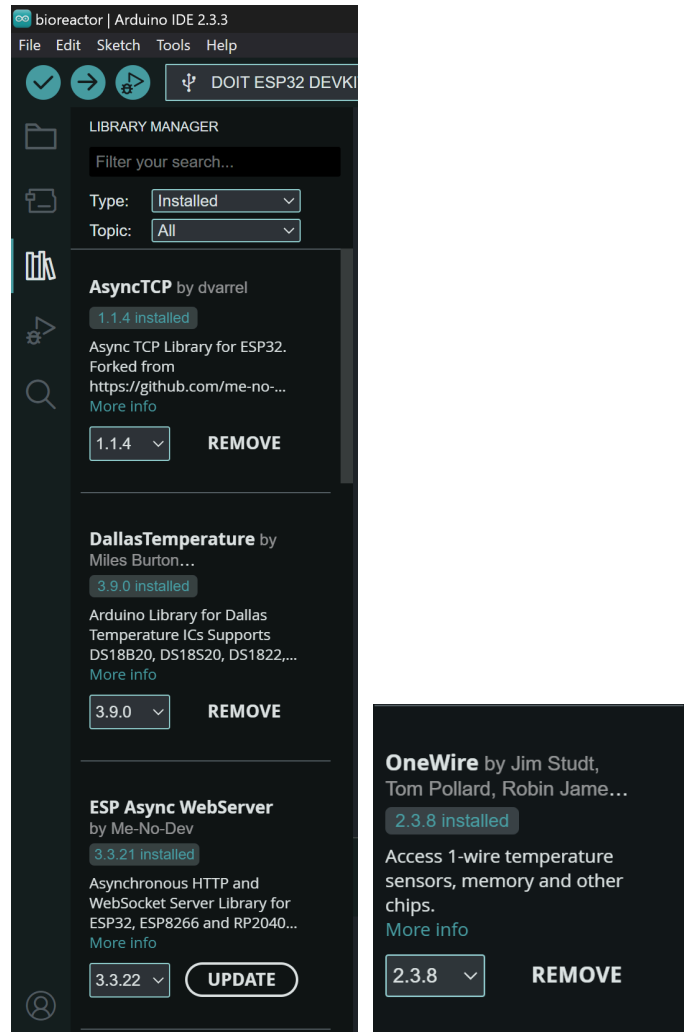
a.

9. Install the “ESP Async WebServer by Me-No-Dev” library.



a.

10. Ensure that the libraries below were installed correctly.



a.

11. Add your network name in the parentheses in line 18.

```
18  const char* ssid = ""; //Enter your WIFI SSID
19  const char* password = ""; //Enter your WIFI password
```

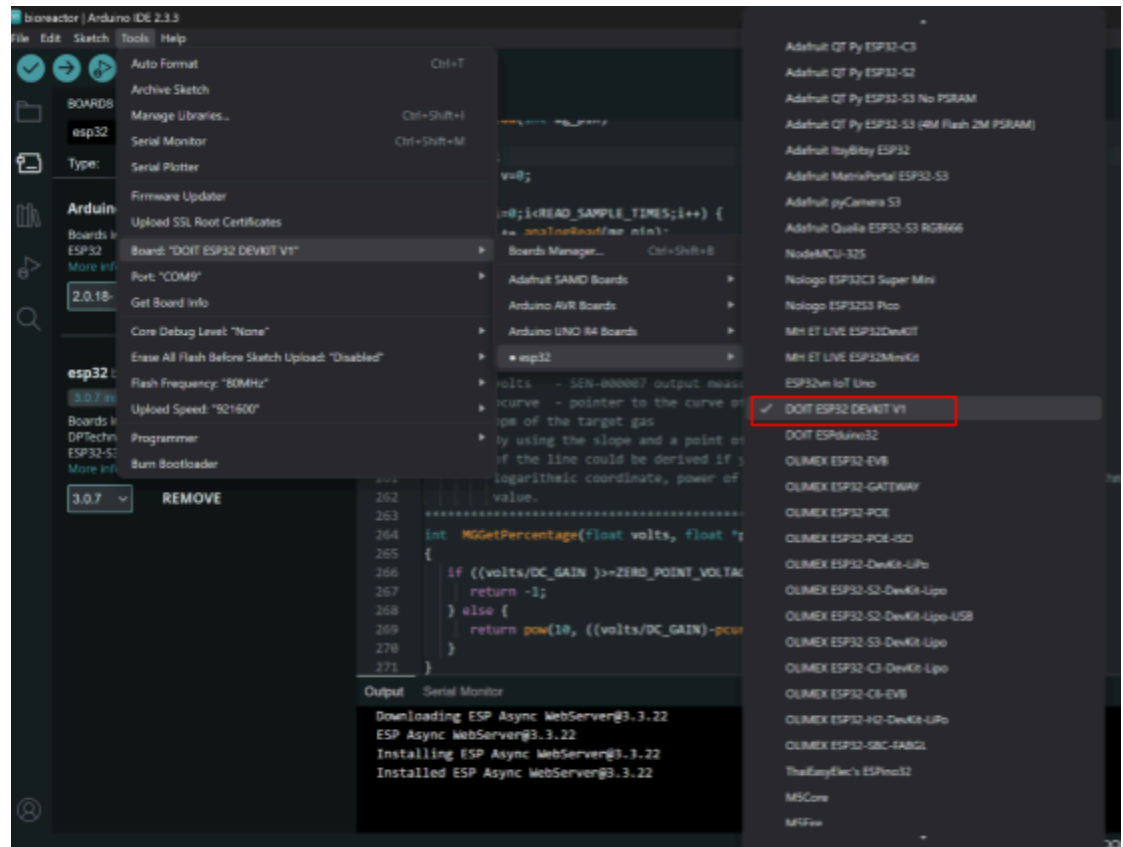
a.

12. Add your network password in the parentheses in line 19.

```
18  const char* ssid = ""; //Enter your WIFI SSID
19  const char* password = ""; //Enter your WIFI password
```

a.

13. Choose the “DOIT ESP32 DEVKIT V1” board.



a.

14. Plug the ESP32 into your computer.

15. Choose the Port the ESP32 is connected to.

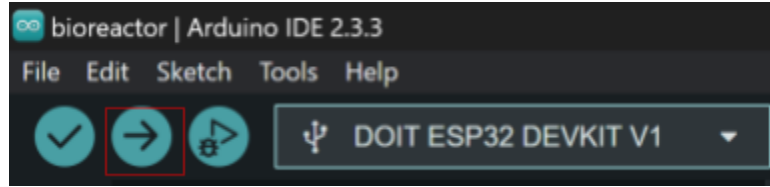


a.

b. *Note:* the port number varies from computer to computer.

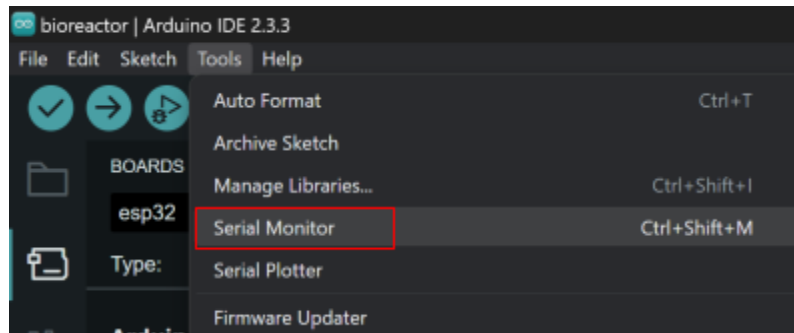
i. To find out what your port number is: unplug the ESP32 and see which port disappears

16. Upload the code to the ESP32 by clicking the arrow in the top left corner.



- a.
- b. *Note:* If the code doesn't upload, reupload while holding the boot button on the ESP32 until "Connecting..." appears in the output.

17. Open the serial monitor at 115200 baud.

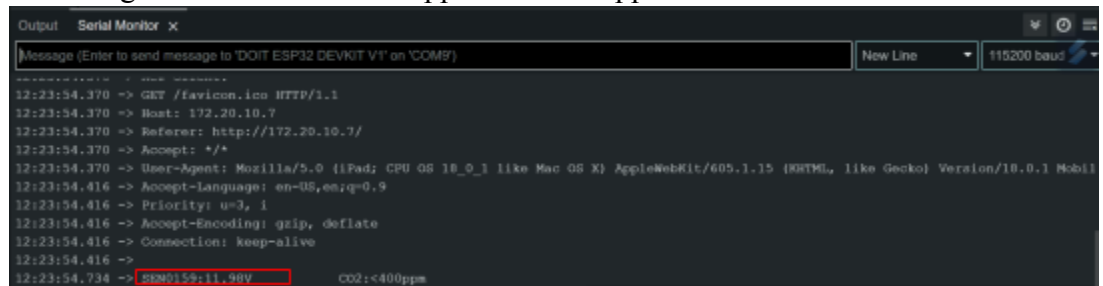


- a.



- b.

18. Record the voltage measurement at 400 ppm and 1000 ppm.



- a.

19. Divide the voltage value at 400 ppm by 8.5. Then, insert the divided value inside the parentheses in line 52 of the code.

```
51 //These two values differ from sensor to sensor. user should derermine this value.
52 #define ZERO_POINT_VOLTAGE (0.761) //define the output of the se
53 #define REACTION_VOLTAGE (0.02) //define the voltage drop of t
```

- a.

b. *Note:* For more information:

[https://wiki.dfrobot.com/CO2\\_Sensor\\_SKU\\_SEN0159](https://wiki.dfrobot.com/CO2_Sensor_SKU_SEN0159)

20. Take the difference in the voltage measurements at 400 ppm and 1000 ppm. Then, divide the difference by 8.5 and insert the value inside the parentheses in line 53.

```
51 //These two values differ from sensor to sensor. user should derermine this value.
52 #define ZERO_POINT_VOLTAGE (0.761) //define the output of the se
53 #define REACTION_VOLTAGE (0.02) //define the voltage drop of t
```

- a.

21. Upload the new code to the ESP32.

22. To access the website, type the IP address in the serial monitor as the URL.

a.



```
Output  Serial Monitor x
Message (Enter to send message to 'DOIT ESP32 DEVKIT V1' on 'COM9') New Line 115200 baud
-----
12:23:54.370 -> GET /favicon.ico HTTP/1.1
12:23:54.370 -> Host: 172.20.10.7
12:23:54.370 -> Referer: http://172.20.10.7/
12:23:54.370 -> Accept: */*
12:23:54.370 -> User-Agent: Mozilla/5.0 (iPad; CPU OS 10_0_1 like Mac OS X) AppleWebKit/605.1.15 (KHTML, like Gecko) Version/10.0.1 Mobile/10A523.48E Safari/605.1.15
12:23:54.416 -> Accept-Language: en-US,en;q=0.9
12:23:54.416 -> Priority: u=3, i
12:23:54.416 -> Accept-Encoding: gzip, deflate
12:23:54.416 -> Connection: keep-alive
12:23:54.416 ->
12:23:54.734 -> SSM0159:11.98V CO2:<400ppm
```