

A background image of a mangrove landscape. In the foreground, there are mangrove trees with green leaves and brown trunks. In the middle ground, there is a body of water reflecting the sky and trees. In the background, there are more mangrove trees and a white bird, possibly a heron, standing on a small patch of land. The overall scene is bright and sunny.

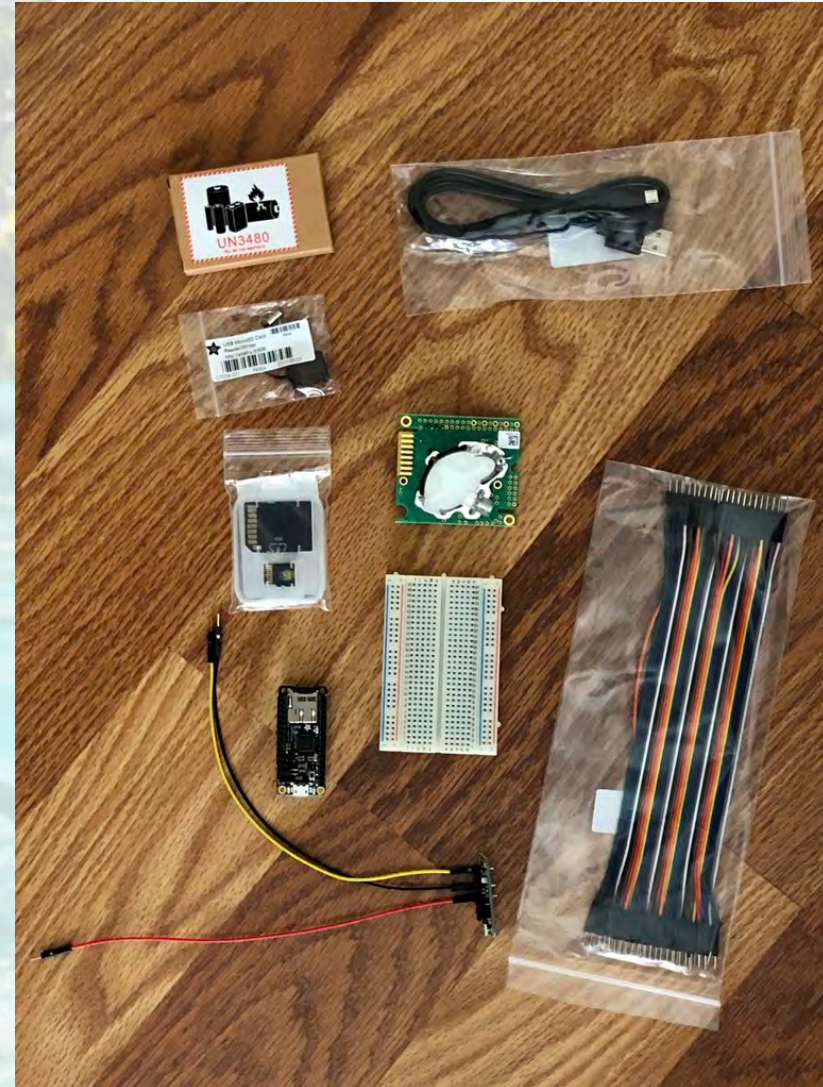
OCN 390: Field Methods


Week 7

Sensor assembly review,
field study design, and
data/metadata collection

Announcements

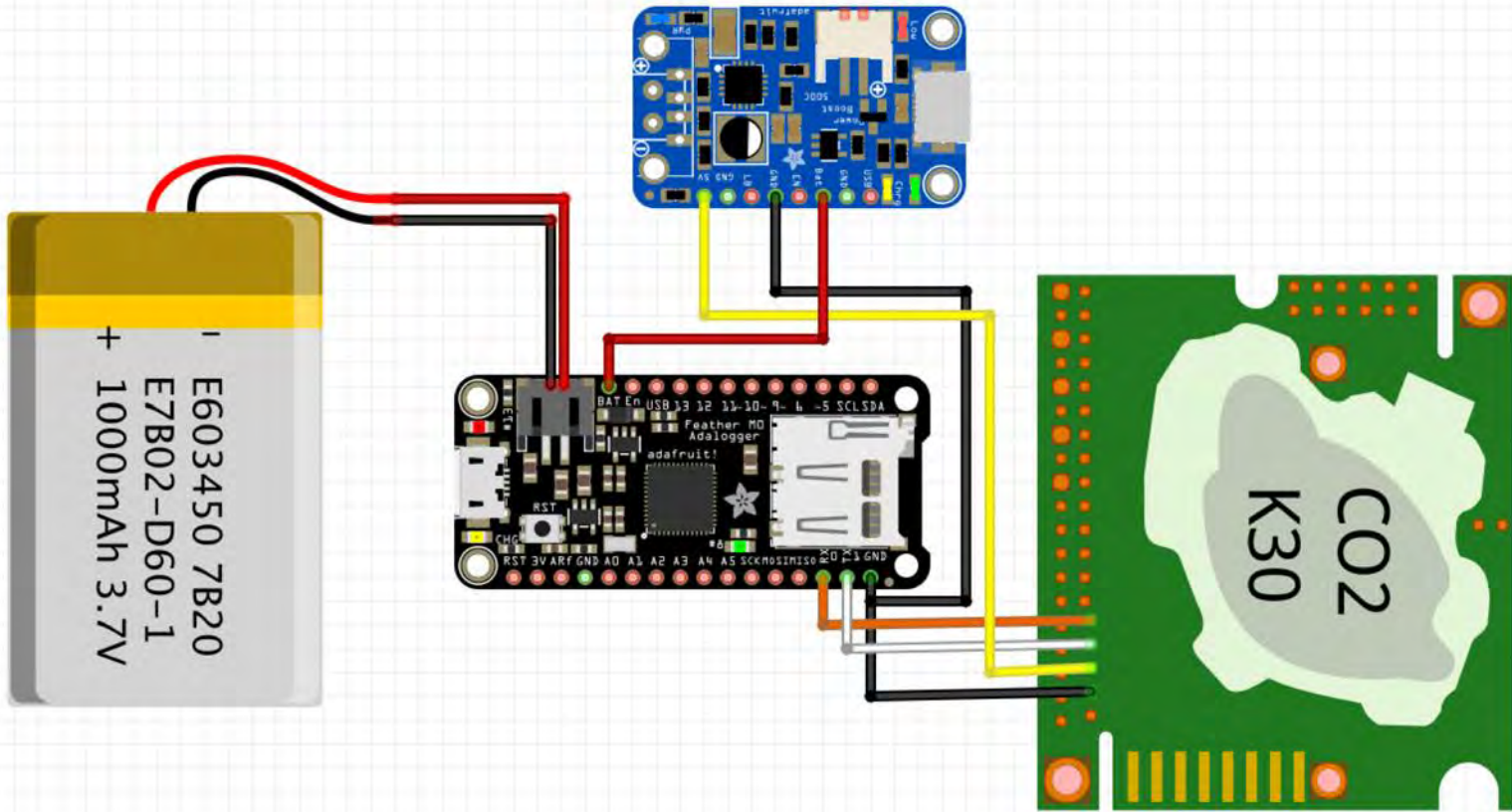
- Please take advantage of reaching out to me and Jack as early in the week as possible so that we can offer guidance!
- Rotate who is the keeper of the components
- Rotate who submits the group assignment
- CC your teammates on emails to me or use the Canvas groups for communicating



A photograph of a mangrove forest with dense green foliage and prominent prop roots extending into the water. The image is semi-transparent, serving as a background for the text.

**Questions from last
few weeks?**

Sensor Assembly Review

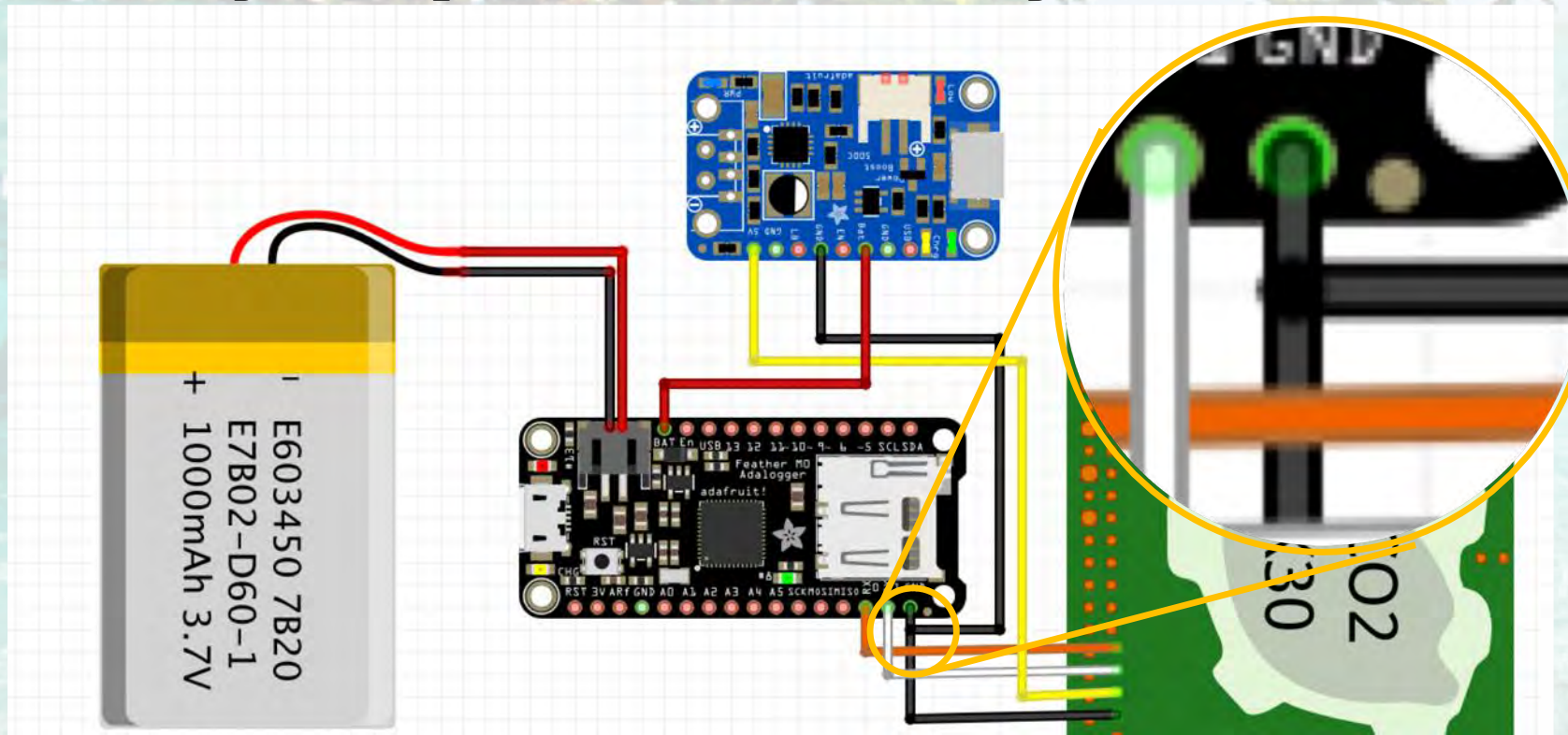


Value of the Breadboard

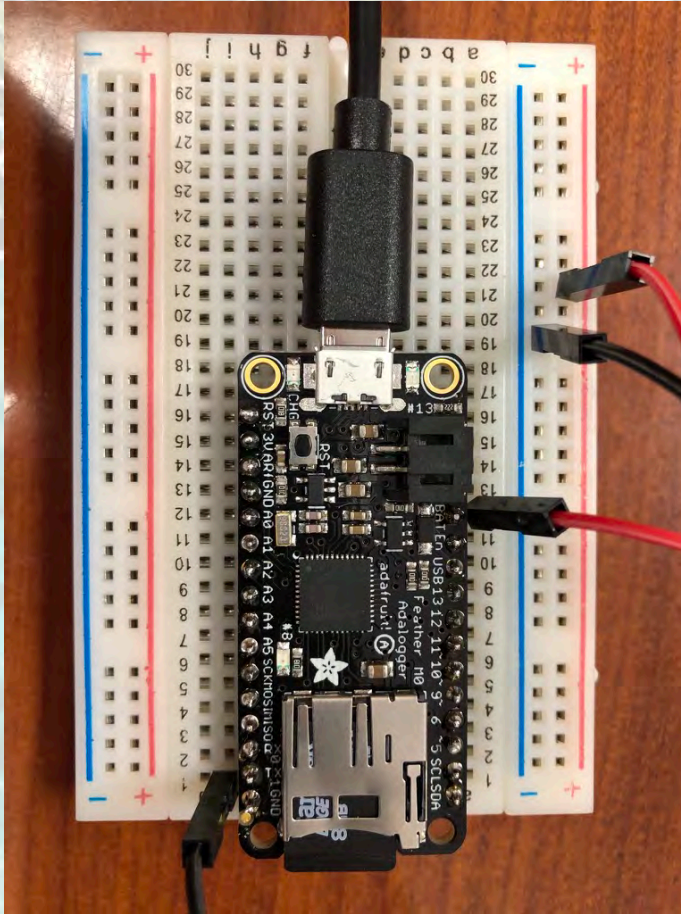
1. Holds things in place
2. Allows multiple common connections without soldering/complicated wiring

Value of the Breadboard

1. Holds things in place
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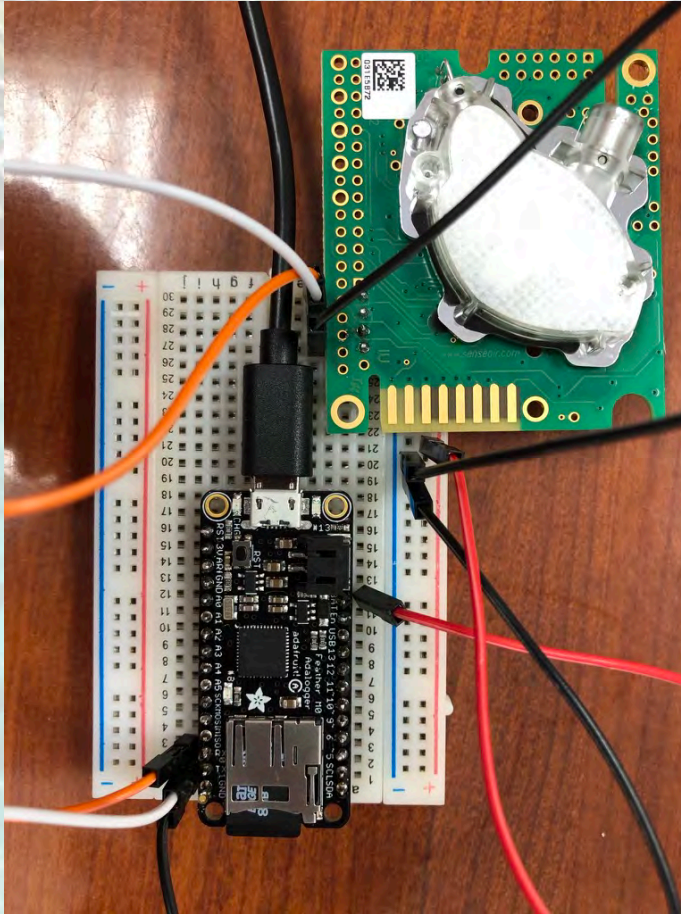


Step 1



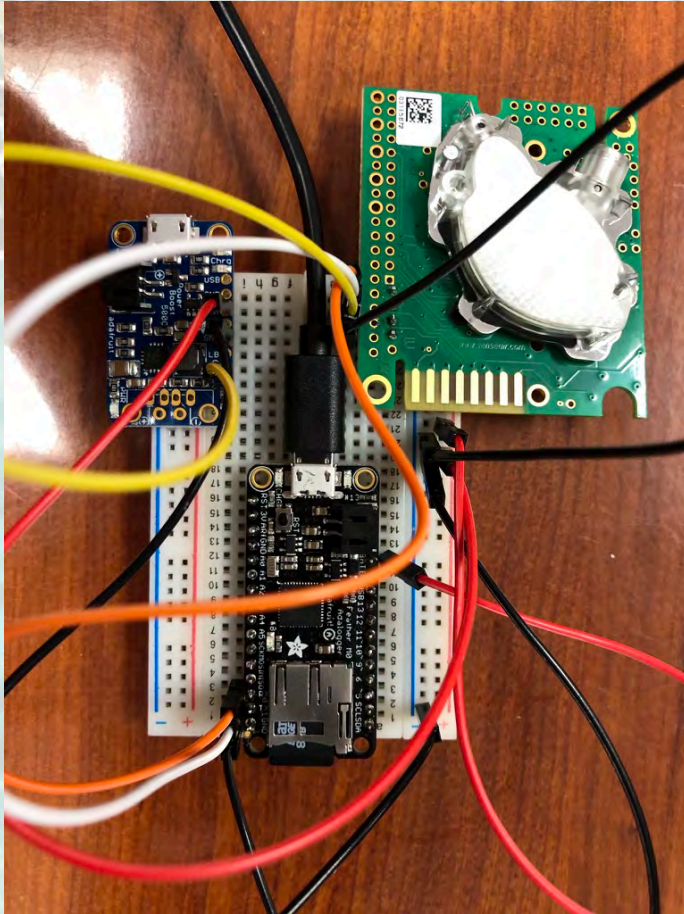
- Power (battery) and ground rails

Step 2



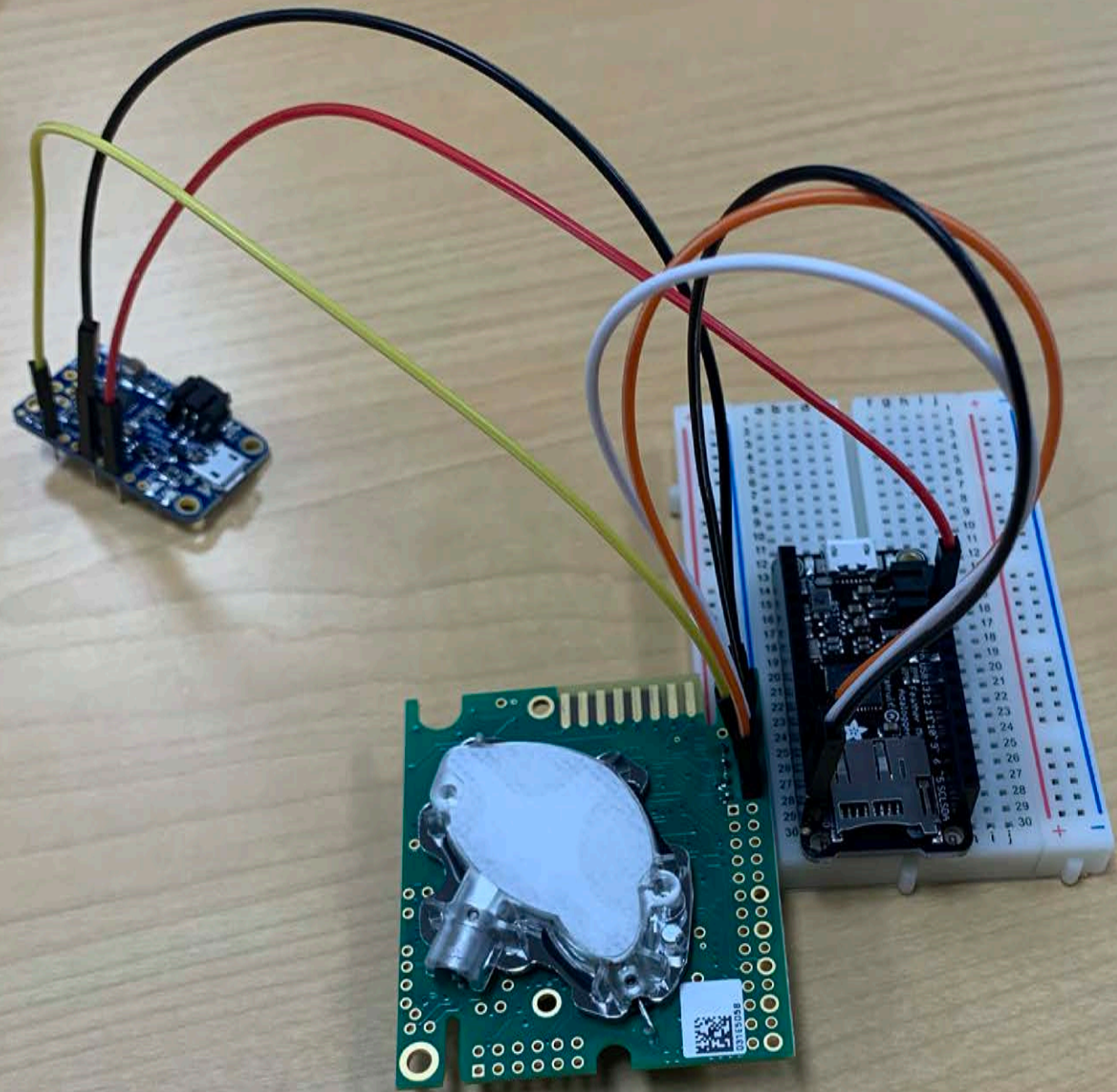
- K-30 and communications

Step 3

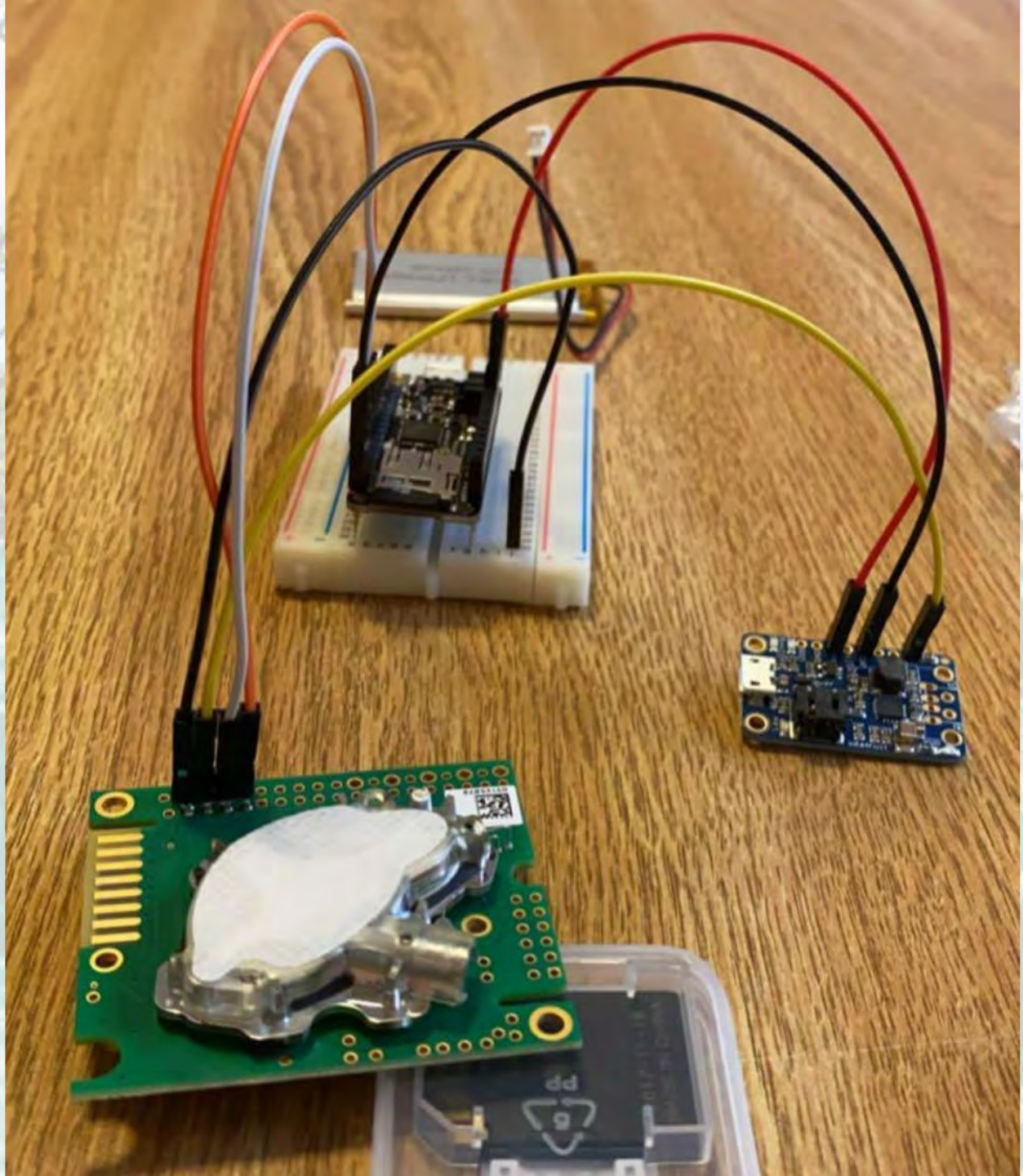


- Increased power for K-30

Common Issues



Common Issues




Blinking LED

- Why?

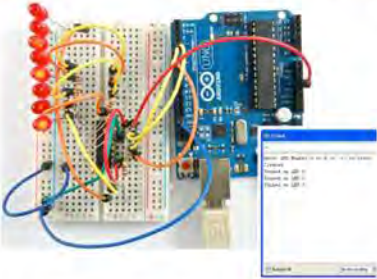


Another option: the Serial Monitor

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**Arduino Lesson 5.
The Serial Monitor**

By [Simon Monk](#)

Learn Arduino, Lesson 5. The Serial Monitor

[Overview](#)
[The Serial Monitor](#)
[Arduino Code](#)
[Other Things to Do](#)

The Serial Monitor

Upload the following sketch to your Arduino. Later on, we will see exactly how it works.

[Download: file](#) [Copy Code](#)

```
1  /*
2  Adafruit Arduino - Lesson 5. Serial Monitor
3  */
4
5  int latchPin = 5;
6  int clockPin = 6;
7  int dataPin = 4;
8
9  byte leds = 0;
10
11 void setup()
12 {
13   pinMode(latchPin, OUTPUT);
14   pinMode(dataPin, OUTPUT);
15   pinMode(clockPin, OUTPUT);
16   updateShiftRegister();
17   Serial.begin(9600);
18   while (!Serial); // Wait until Serial is ready - Leonardo
19   Serial.println("Enter LED Number 0 to 7 or 'x' to clear");
20 }
21
```

[Like](#)

Difficulty: Beginner


Guide Type: Tutorial

Categories: [Components](#)
[LEDs](#)
[Arduino Compatibles/Learn Arduino](#)


Groups: [Learn Arduino](#) (6 of 18)

42 Likes


Featured Products




USB Cable - Standard A-B
\$2.95
[Add to Cart](#)



Diffused Red 5mm LED (25 pack)
\$4.00
[Add to Cart](#)



74HC595 Shift Register

A photograph of a mangrove landscape. In the foreground, the dark, tangled roots of mangrove trees are visible in the shallow, clear water. The water reflects the sky and the surrounding greenery. In the background, there are more mangrove trees with dense green foliage. The sky is bright blue with some white clouds. The overall scene is peaceful and natural.

Preparing for Fieldwork

Field Study Design Considerations: Example Simple Checklist

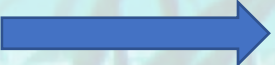
- ☐ Always start with the question: "why am I planning this field study?" What do you hope to get out of it?
- ☐ Check weather, tides, map out area
- ☐ Alert others you are going; go with someone else (covid complicates this)
- ☐ What do you need to bring?
 - ☐ Personal protective gear (gloves, safety/sunglasses, hat, sunscreen)
 - ☐ Communication equipment (phone, extra phone battery, radio, EPIRB if remote work)
 - ☐ Work clothes
 - ☐ Work shoes/boots
 - ☐ Water/food if long expedition
 - ☐ Tools for fieldwork:
 - ☐ Sensors/analyzers
 - ☐ Power for the above (batteries, fuel)
 - ☐ Bottles or other storage containers for samples
 - ☐ Hand/power tools
 - ☐ Rope, cable
 - ☐ Survey tools (tape measure, depth finder, quadrat, etc.)
- ☐ What else?

Field Study Design Considerations: Example Simple Checklist

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 - ☐ Work clothes
 - ☐ Work shoes/boots
 - ☐ Water/food
 - ☐ Tools
 - ☐ First aid kit
 - ☐ Spare parts (batteries, fuel)
 - ☐ Other storage containers for samples
 - ☐ Other tools
 - ☐ Rope, cable
 - ☐ Survey tools (tape measure, depth finder, quadrat, etc.)
- ☐ What else?

Just a simple example
Make your own for your field study!

Field Study Design Considerations: Example Simple Checklist

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Power Budget for Oceanographic Sensor

- How do you figure out how long something will last in the field?

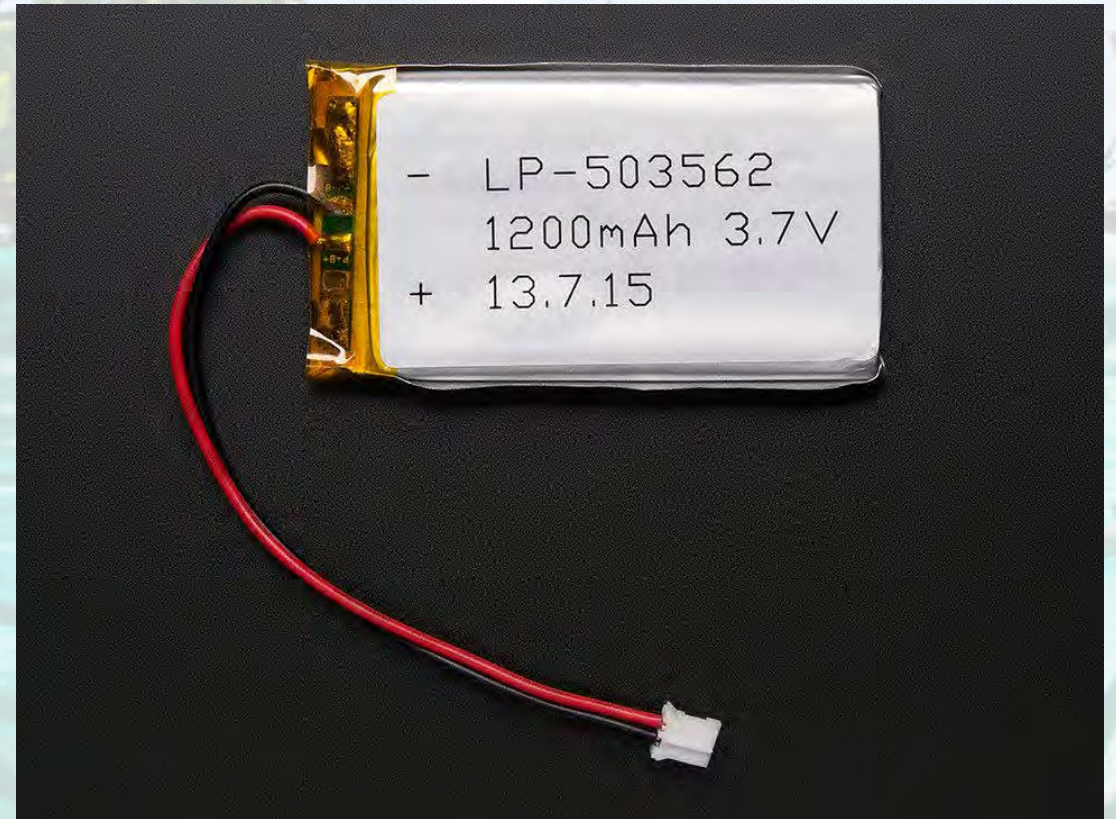
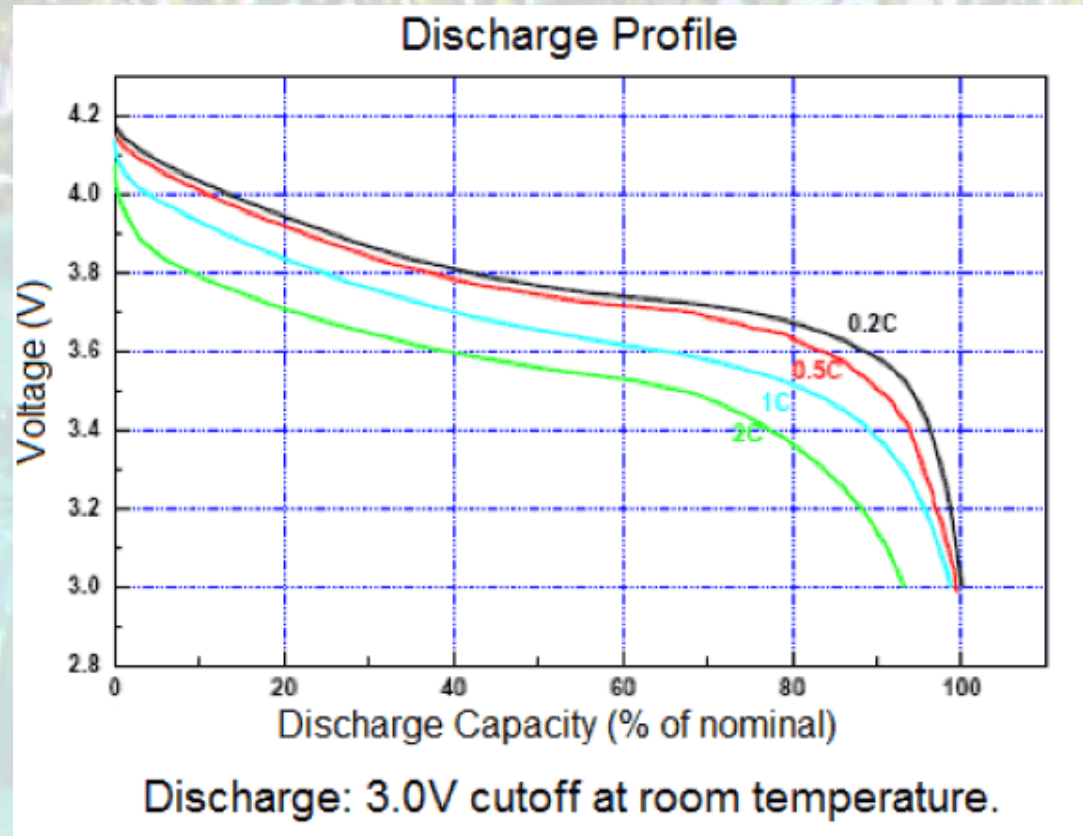
Power Budget for Oceanographic Sensor

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Electrical/Mechanical

Power Input.....	5-14 VDC, stabilized to within 10%
Current Consumption	40 mA average
	< 150 mA peak current (averaged during IR lamp ON, 120 msec)
	< 300 mA peak power (during IR lamp start-up, the first 50 msec)
Dimensions	5.1 x 5.7 x 1.4 cm (Length x Width x approximate Height)
Electrical Connections	Terminals not mounted (G+, G0, OUT1, OUT2, Din1, Din2, Status, TxD, RxD)

3.7 V “nominal”



<https://community.particle.io/t/can-argon-or-xenon-read-the-battery-state/45554/45?u=fragma>

<https://www.adafruit.com/product/258>

Simple Estimate

- We have $1200 \text{ mA} \cdot \text{hr} * 3.7 \text{ V} = 4.44 \text{ W} \cdot \text{hr}$
- We will use $> 40 \text{ mA} * 5 \text{ V}$ (for K-30; ignore microcontroller for now) $= 200 \text{ mW} = 0.2 \text{ W}$

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- So $4.44 \text{ W} \cdot \text{hr} / 0.2 \text{ W} = 22 \text{ hours}$
- Microcontroller, especially SD card write function, and PowerBoost also consume power. This is just for illustrative purposes!
- Should measure/test this value, especially for remote deployments

A photograph of a mangrove landscape. In the foreground, the dark, silty water of a tidal flat is visible, with numerous prop roots of mangrove trees extending from the water. In the middle ground, there are several mangrove trees with dense green foliage. The background shows a bright, slightly hazy sky with some clouds. The overall scene is a natural, coastal environment.

Data and Metadata

Data vs. Metadata

- Data:
 - A measurement (from a sensor, analyzer, a ruler, etc.)
 - Observations, including numbers and words

Data vs. Metadata

- Data:

- A measurement (from a sensor, analyzer, a ruler, etc.)
- Observations, including numbers and words

- Metadata

- Data about the data
- How were data collected?
- What was the instrument?
- When was it last calibrated?
- What are its calibration coefficients?
- Who made the measurement?

Why?

- Research is meant to be reproducible
 - By you
 - By anyone who reads your paper, lab notebook, etc.
- You'll remember very little of your past work after weeks/months/years


```
1 Current time 5/22/2019 15:14
2 First sample 5/22/2019 15:14
3 Time zone Local
4 File name tanktest.txt
5 User initials tw
6 Sampling period (s) 900
7 Standard interval 192
8 Standard multiple 2
9 pH Sample average 10
10 Pump on time (s) 10
11 Valve on time (s) 10
12 Sample Delay (s) 35
13 Standard Delay (s) 35
14 Low battery voltage (V) 10
15 TCOffset 0
16 Eo_int_25C -0.4
17 Eo_ext_25C -1.4
18 Default salinity (ppt) 33.5
19 Sensor name na
20 DuraFET SN na
21 CAP adapter SN na
22 ISE SN na
23 MicroCAT SN na
24 Pump SN na
25 Pressure sensor full-scale (psi) 100
26 Vint gain 1
27 Vint sample rate (sps) 5
28 Deploy mode (pump on)
29
```

Sample #	Sample Time	Main Batt	Vtherm	Vint	Vext Ref	Iso Batt	Controller Temp	pH Temp	Pressure (dBar)	pH Int	pH Ext	Counter	Le		
#000000	5/22/2019 15:14	15.96	1.1449	0.049919	-1.003229	5.71	22.84	20.171	0.032	7.639134	6.124978	0	0.3379	5730	15
#000001	5/22/2019 15:30	15.96	1.15816	0.050541	-1.00323	5.73	21.98	19.784	0.063	7.652584	-0.01345	6.128183	0	0.3842	57
#000002	5/22/2019 15:45	15.96	1.16591	0.050774	-1.003203	5.73	21.57	19.56	0.057	7.658213	-0.005629	6.129792	0	0.4149	57
#000003	5/22/2019 16:00	15.96	1.17086	0.05083	-1.003249	5.71	21.33	19.417	0.141	7.660209	-0.001996	6.129409	0	0.4303	5730
#000004	5/22/2019 16:15	15.96	1.17413	0.050962	-1.00317	5.71	21.17	19.323	0.112	7.663165	-0.002956	6.130948	0	0.4469	57
#000005	5/22/2019 16:30	15.96	1.17641	0.051031	-1.003147	5.71	21.05	19.258	0.109	7.66483	-0.001665	6.131639	0	0.4468	5730
#000006	5/22/2019 16:45	15.96	1.17829	0.051071	-1.003129	5.73	20.96	19.204	0.136	7.665905	-0.001075	6.132409	0	0.4691	57

METADATA

COLUMN HEADERS

DATA

```

1 Current time 5/22/2019 15:14
2 First sample 5/22/2019 15:14
3 Time zone Local
4 File name tanktest.txt
5 User initials tw
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7 Standard interval 192
8 Standard multiple 2
9 pH Sample average 10
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11 Valve on time (s) 10
12 Sample Delay (s) 35
13 Standard Delay (s) 35
14 Low battery voltage (V) 10
15 TCOffset 0
16 Eo_int_25C -0.4
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19 Sensor name na
20 DuraFET SN na
21 CAP adapter SN na
22 ISE SN na
23 MicroCAT SN na
24 Pump SN na
25 Pressure sensor full-scale (psi) 100
26 Vint gain 1
27 Vint sample rate (sps) 5
28 Deploy mode (pump on)
29

```

Sample #	Sample Time	Main Batt	Vtherm	Vint	Temp	pH	Temp	Pressure (dBar)	pH Int	pH Ext	Counter	Le
#000000	5/22/2019 15:14	15.96	1.1449	0.049919	-1.003		7.639134	6.124978	0	0.3379	5730	15
#000001	5/22/2019 15:30	15.96	1.15816	0.050541	-1.003		7.652584	-0.01345	6.128183	0	0.3842	57
#000002	5/22/2019 15:45	15.96	1.16591	0.050774	-1.003		7.658213	-0.005629	6.129792	0	0.4149	57
#000003	5/22/2019 16:00	15.96	1.17086	0.05083	-1.003249		60209	-0.001996	6.129409	0	0.4303	5730
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#000005	5/22/2019 16:30	15.96	1.17641	0.051031	-1.003		7.66483	-0.001665	6.131639	0	0.4468	5730
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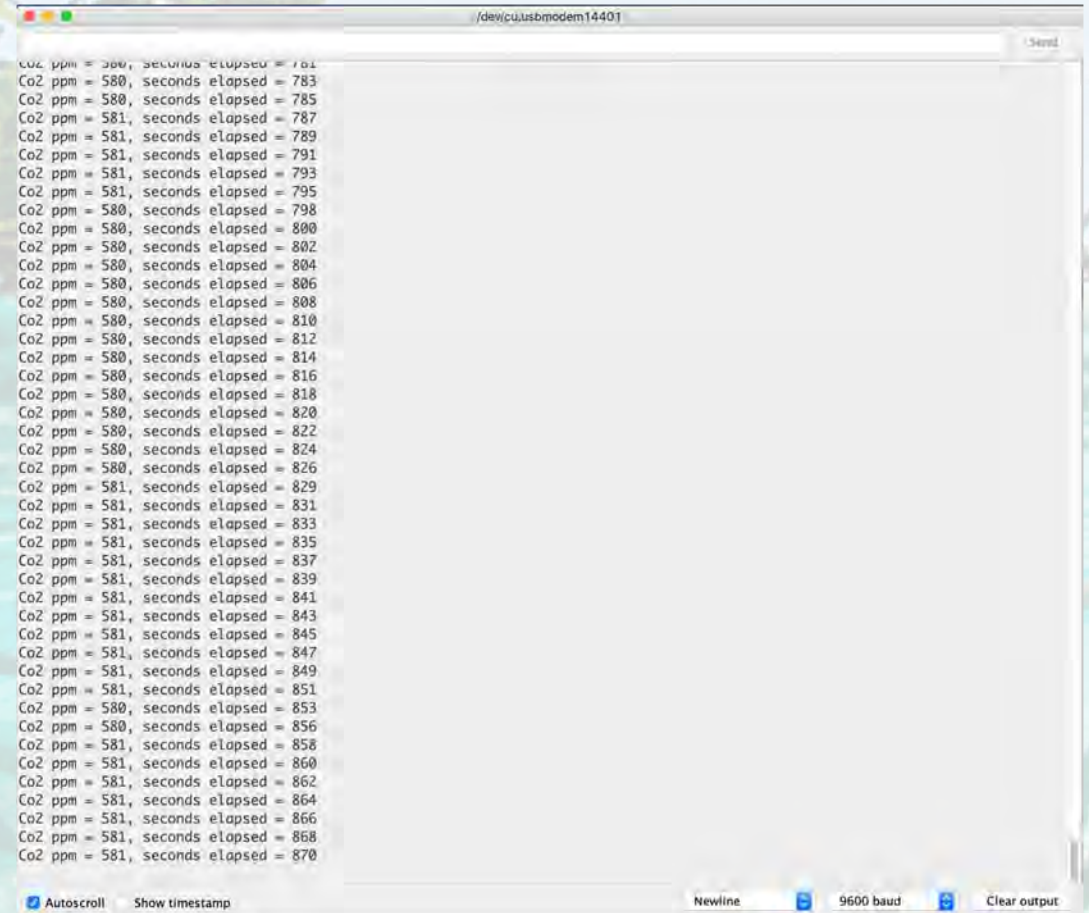
This Week's Assignment

Due Sun., Mar. 7, by 11:59 pm

1. Field Journal
2. Screenshot of your (a) **Arduino serial monitor**
(b) ***displaying CO2 data***
3. Familiarize yourself with the basics of the code (how does it get CO2 data from sensor, how does it print it to the serial monitor)
4. Three ranked ideas (one paragraph of > 3 sentences each) for your group's proposed field study

2. Screenshot of your (a) Arduino serial monitor (b) *displaying CO2 data*

- What is the Arduino serial monitor?
- How do you “debug” (fix) problems when you cannot see what is happening?
 - LEDs or other signal outputs
 - Text to screen
- <https://learn.adafruit.com/adafruit-arduino-lesson-5-the-serial-monitor/the-serial-monitor>



The screenshot shows an Arduino Serial Monitor window titled "/dev/cu.usbmodem14401". The window displays a list of data points for CO2 concentration in ppm and the time elapsed in seconds. The data is as follows:

CO2 ppm	seconds elapsed
580	781
580	783
580	785
581	787
581	789
581	791
581	793
581	795
580	798
580	800
580	802
580	804
580	806
580	808
580	810
580	812
580	814
580	816
580	818
580	820
580	822
580	824
580	826
581	829
581	831
581	833
581	835
581	837
581	839
581	841
581	843
581	845
581	847
581	849
581	851
580	853
580	856
581	858
581	860
581	862
581	864
581	866
581	868
581	870

At the bottom of the window, there are checkboxes for "Autoscroll" (checked) and "Show timestamp" (unchecked). On the right side, there are buttons for "Newline", "9600 baud", and "Clear output".

CO2 Sensor Code

Brief Walkthrough

- https://github.com/uncw-ocean-field-methods/ocn390_2021spring/blob/main/Sensor-Dev/Firmware/k-30_read-and-save/k-30_read-and-save.ino
- How to run code (ORDER IS CRUCIAL!):
 1. Disconnect battery and USB cable from Adalogger
 2. Copy code to your Arduino IDE
 3. Save as new script
 4. Connect battery to Adalogger
 5. Connect USB cable to
 6. Flash code onto Adalogger
 7. Open Serial Monitor and wait for output
 8. Troubleshoot until you see CO2 sensor values. Check that they are reasonable. Blow on sensor (not near others, not without mask unless you're at home!) to see if values increase.

Our sensor:
 CO_2 vs. time



Data vs. metadata

Data

- CO₂ concentration
- Elapsed time
- (Location of measurement)

Metadata

- Start time
- Location
- Weather/conditions
- Other things you notice—journal practice

4. Three ranked ideas (one paragraph of > 4 sentences each) for your group's proposed field study

A few reasons to measure CO₂

- Respiration/photosynthesis of planet/ecosystem/individual
- Air quality for health
- Indoor air quality (circulation/ventilation)
- Atmospheric changes due to humanity
- Emissions monitoring: regional/site-specific
- Air-water flux: how much CO₂ is coming out of/going into water
- Hypercapnia: too much CO₂ in bloodstream
- Professor told you to

- Consider:
 - Staying in one place and observing changes over time—indoors/outdoors/greenhouse
 - Monitoring changes from place to place—different ecosystems, different times of day?
- Each paragraph must outline:
 - What phenomenon you are proposing to study
 - Why it is important
 - How you would execute study
 - How would you collect necessary (meta)data
 - 1 extra credit point added to final grade for references to peer-reviewed literature; you must cite it in context by providing a couple sentences describing the cited study and why it is relevant to your proposal. Provide first author, year of publication, article name, and link to article. Peer reviewed lit will be required for final report.

Health

The coronavirus is airborne. Here's how to know if you're breathing other people's breath.

In a major new pandemic trend, people are turning to carbon dioxide monitoring devices to help assess ventilation quality



Bri Yeager, a server at Railroad Pub & Pizza in Burlington, Wash., prepares a table for diners. To keep his businesses open during the pandemic, restaurant owner Nick Crandall leaves the pub's garage doors open and uses a carbon dioxide monitor to track air quality in the space. (Jovelle Tamayo for The Washington Post)

By **Chris Mooney**

Feb. 10, 2021 at 8:26 a.m. EST

Add to list

With its five wall-length windows, Nick Crandall's restaurant, Railroad Pub & Pizza, can bring in a lot of outside air. In late December, though, Washington state regulators said the restaurant could not qualify



- “Now Crandall’s restaurant is open again — with a CO2 monitor that displays a reading he tries to keep under 450 parts per million, only slightly higher than levels in the outside air, per state policy. Thanks to the human burning of fossil fuels, outdoor levels currently average about 415 parts per million, and are steadily rising.”

CO2Meter Product Showcase



SE-0018
CM-0024

**K30 10,000ppm CO2
Sensor**

[Buy Now](#)



RAD-0102-6

**Remote CO2 Storage
Safety 3 Alarm**

[Buy Now](#)



AR-4HOME

**Aranet4 HOME Indoor Air
Quality Monitor**

[Buy Now](#)

Putting it all together

- We know how to wire the sensor
- We know how to program it
- We know what data it collects and what we have to collect in order to have a complete/usable dataset
- We know how to start planning fieldwork
- Time to design our field studies

Next Week

- Weather permitting, we'll collect some indoor/outdoor data so dress for partially outdoor class.
- One person per team: download Strava app for your phone

