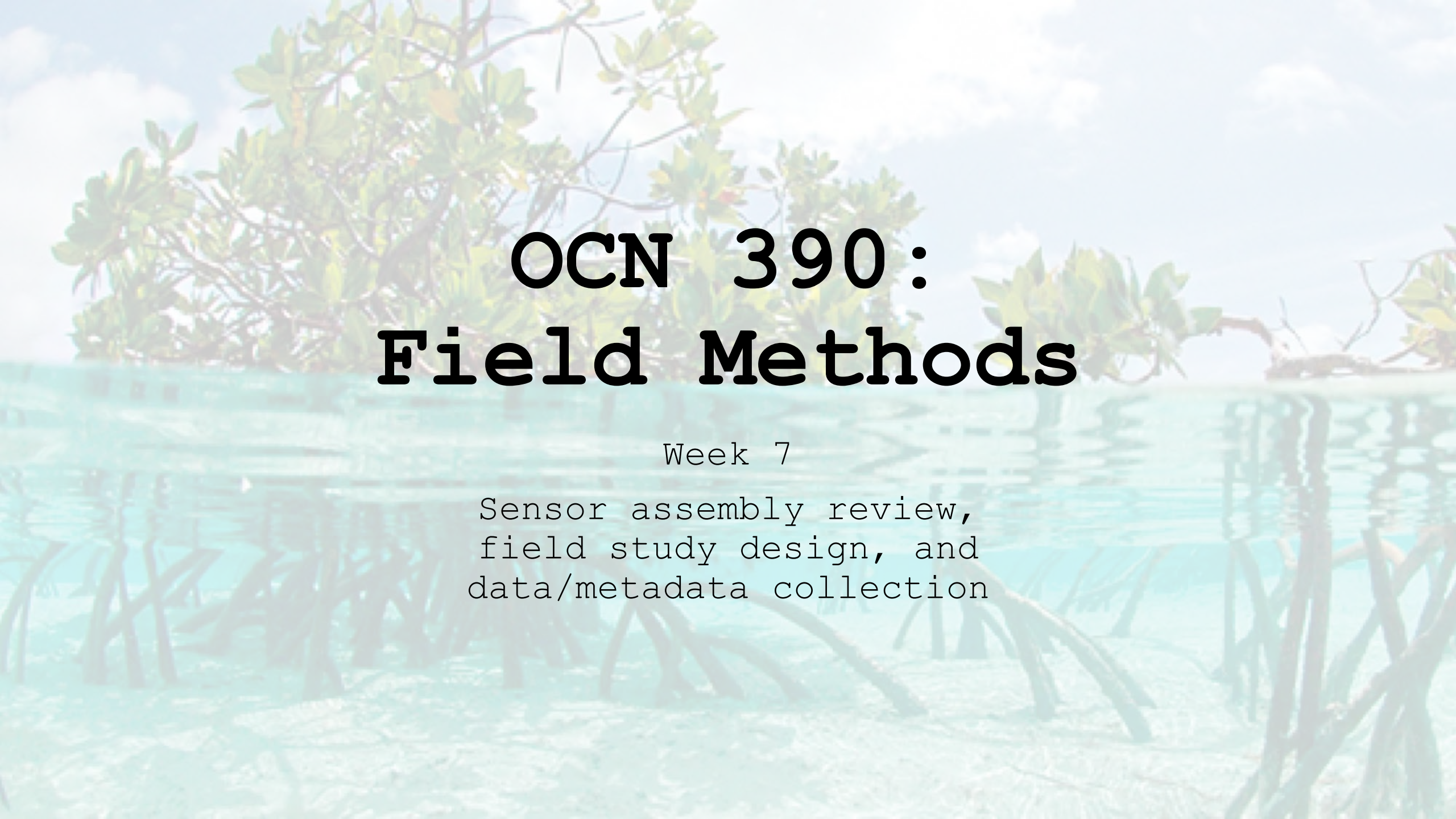


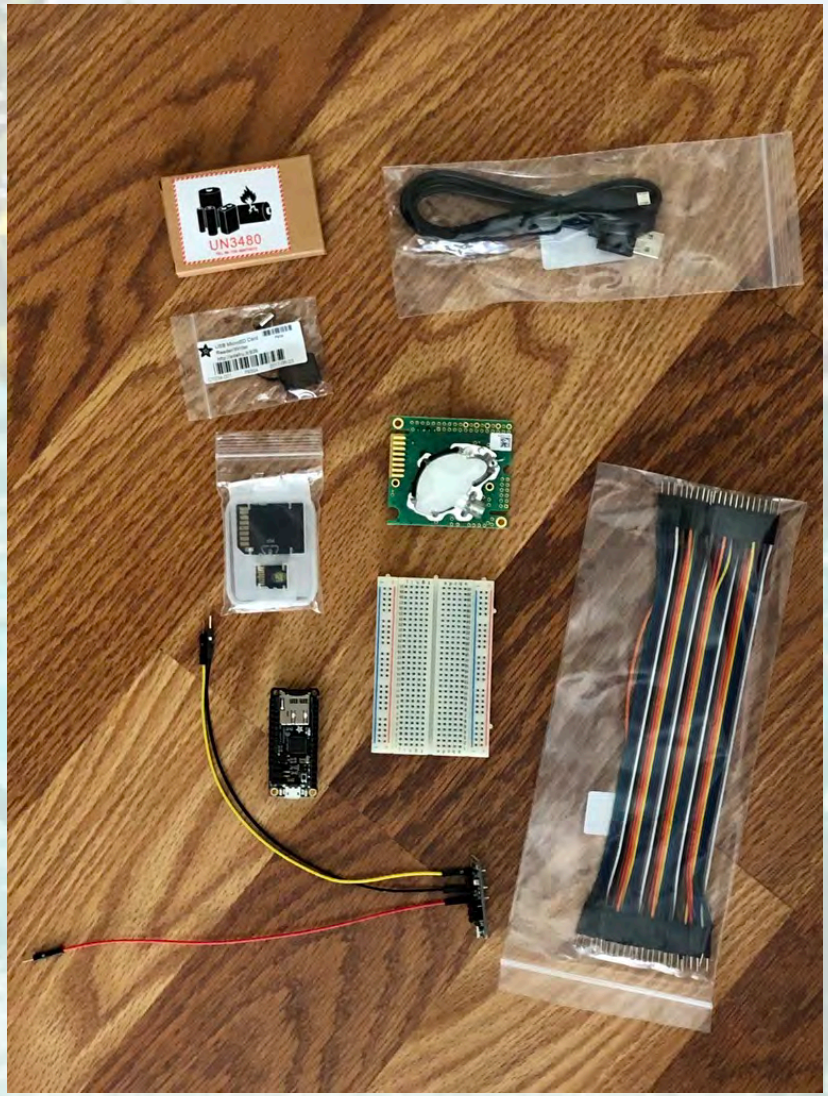
OCN 390: Field Methods

Week 7

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

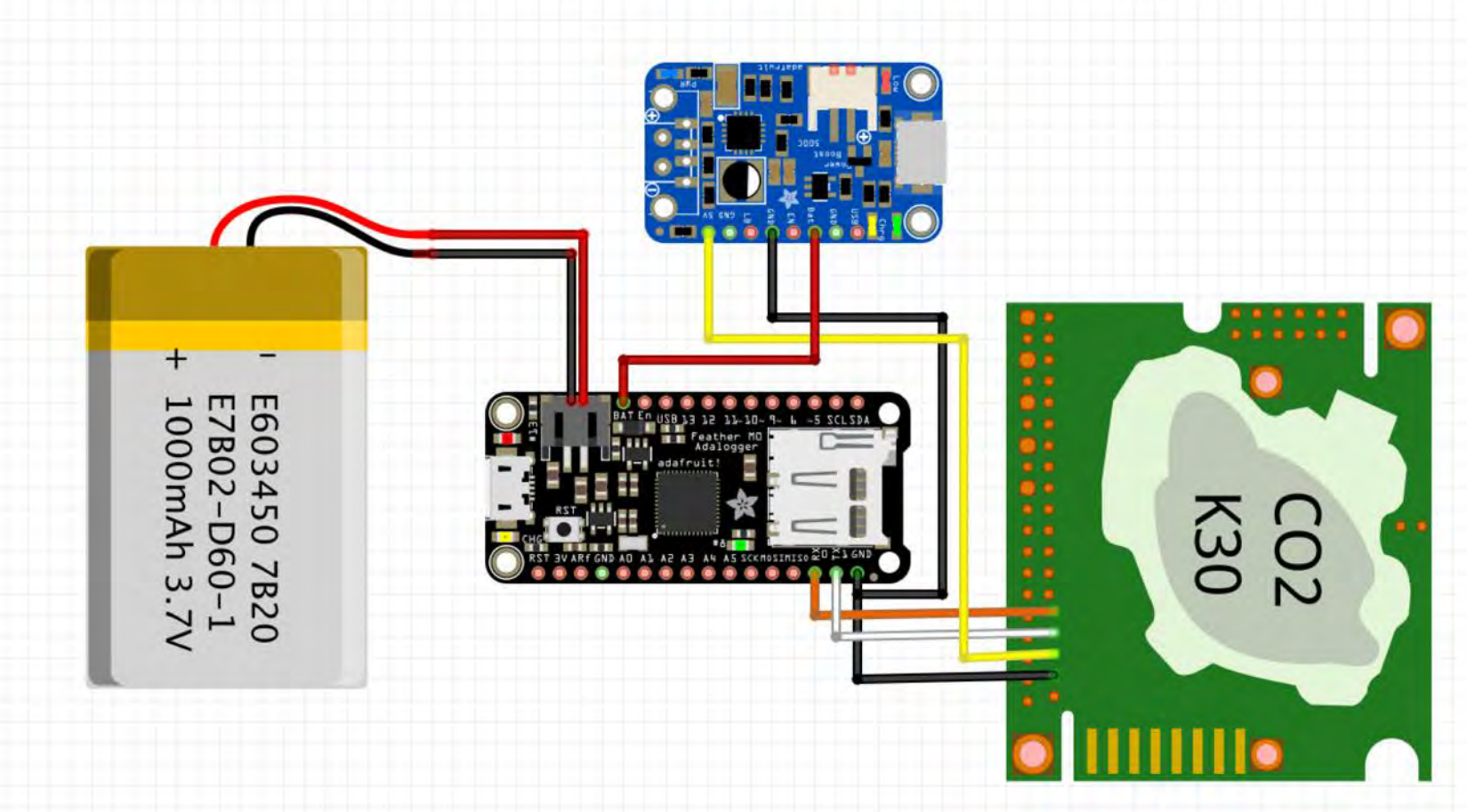
Announcements

- 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




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

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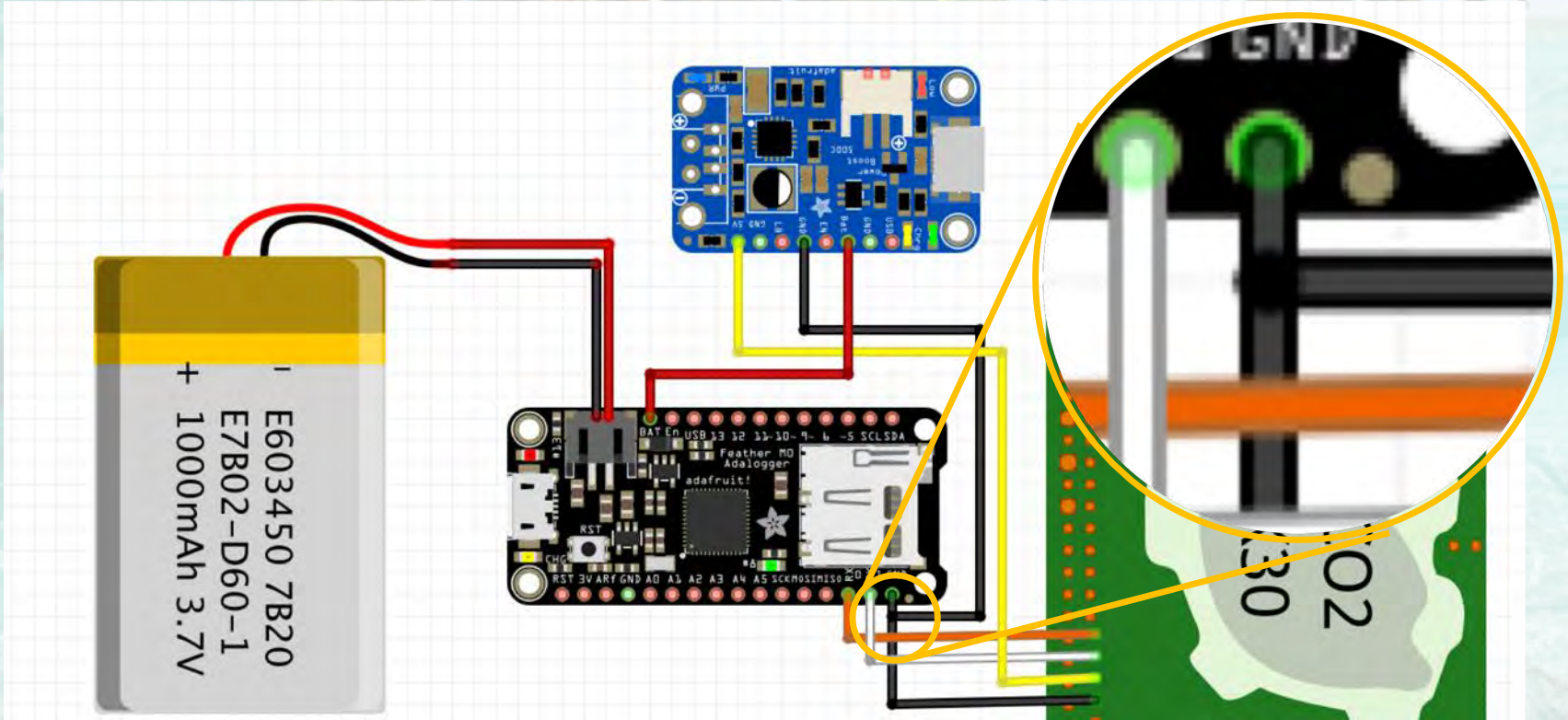
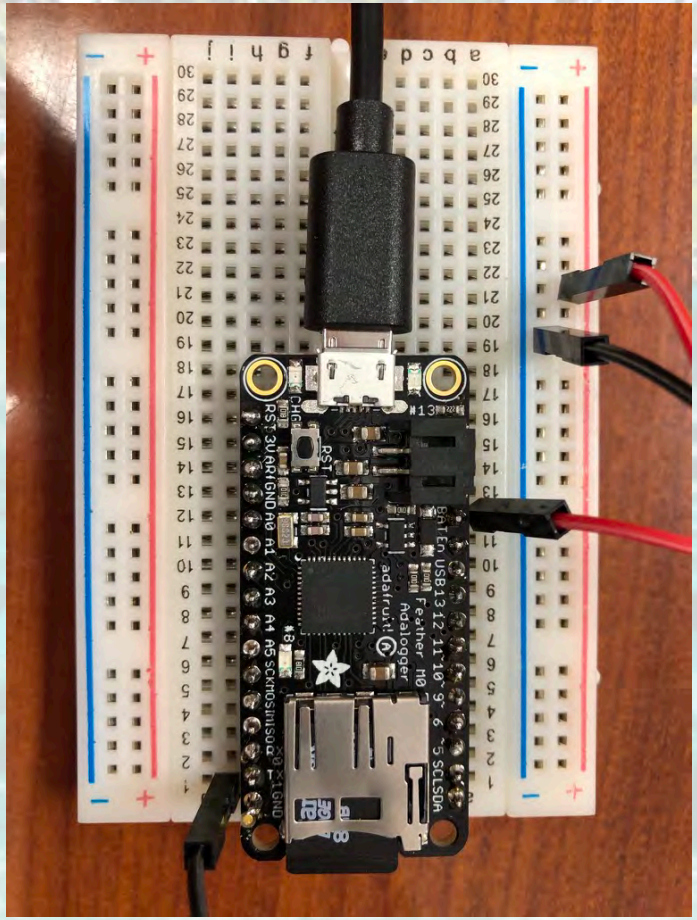
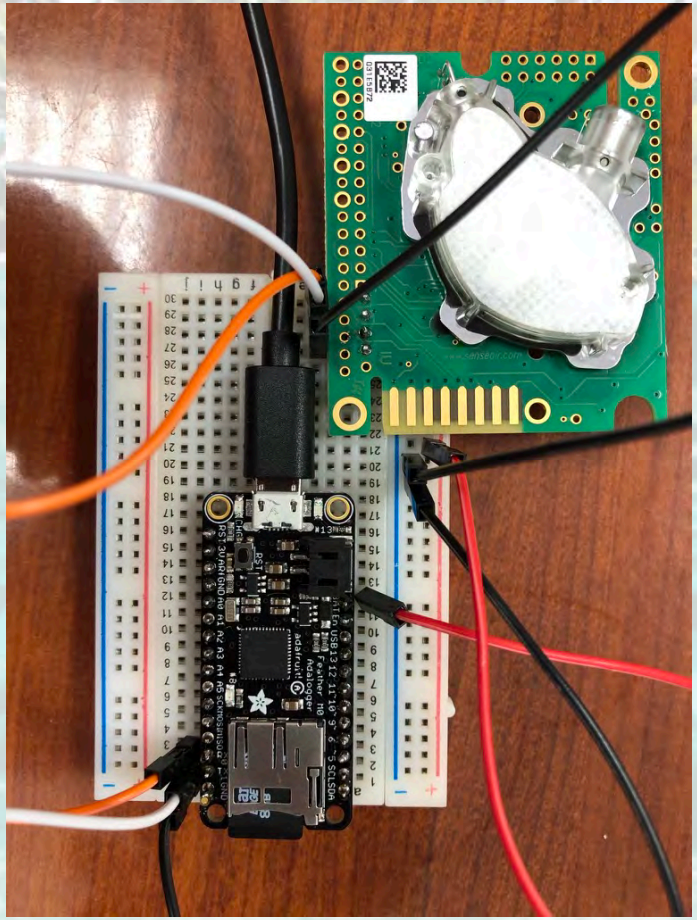


Step 1



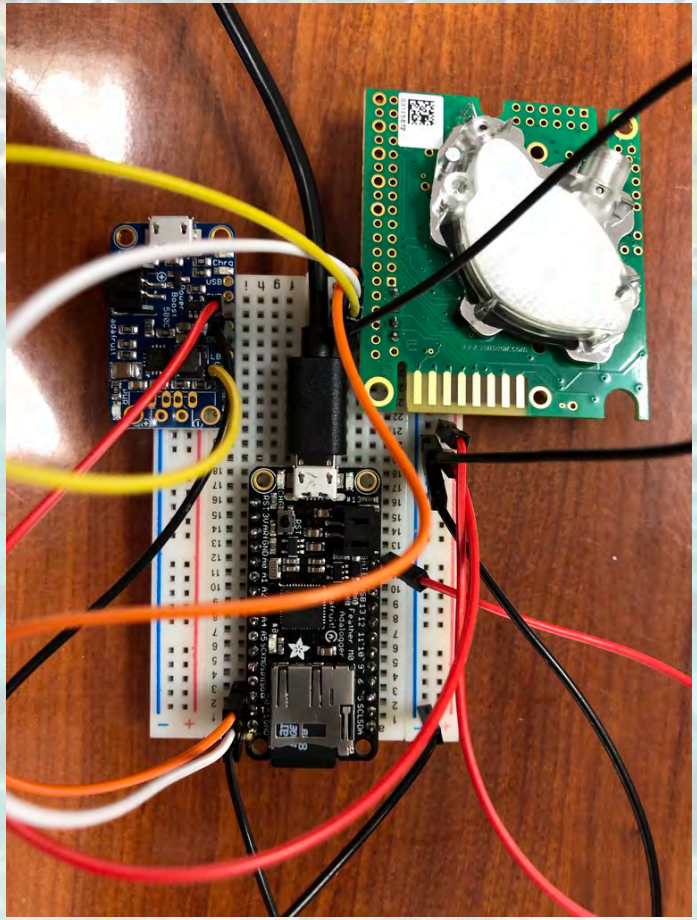
- Power (battery) and ground rails

Step 2



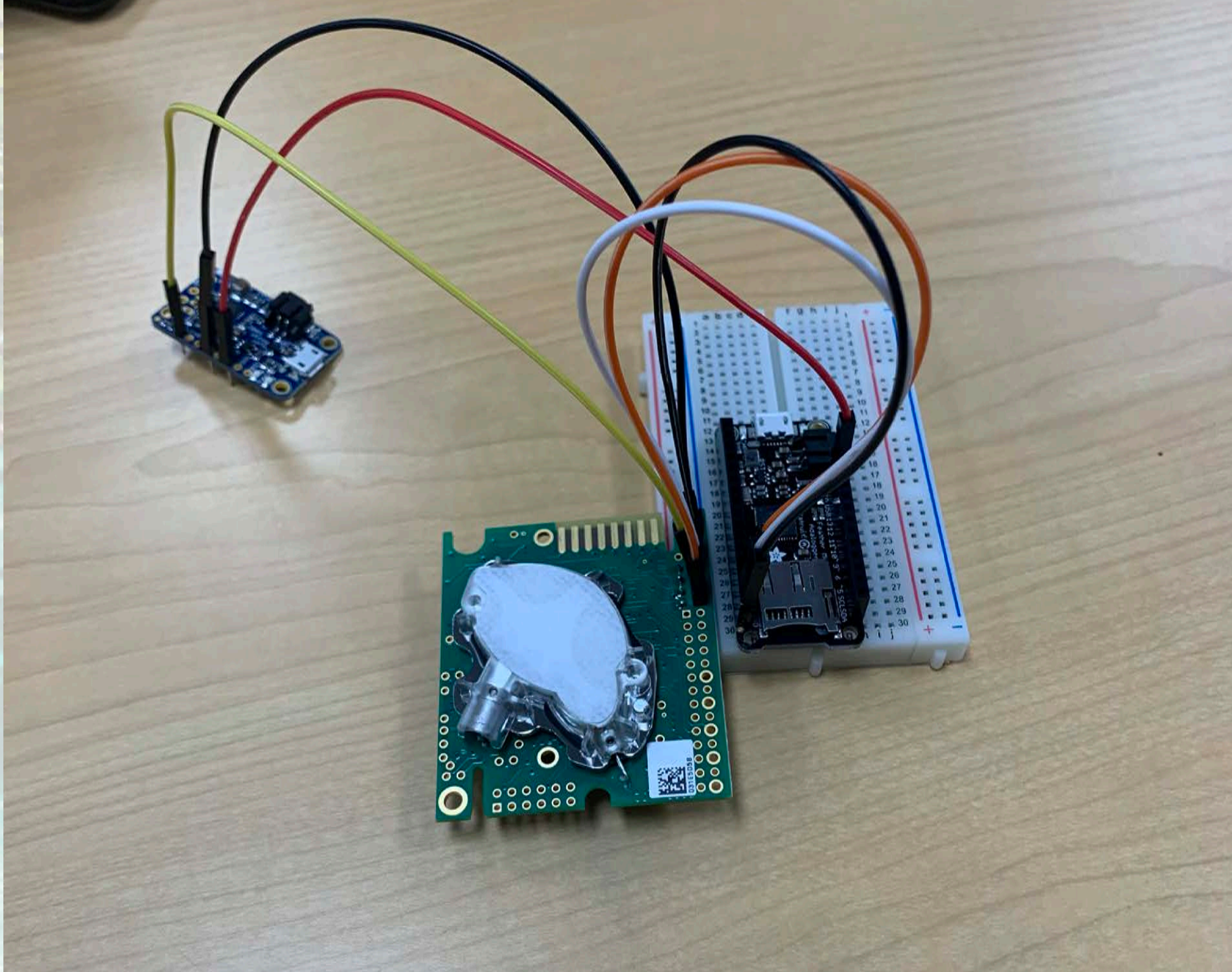
- K-30 and communications

Step 3

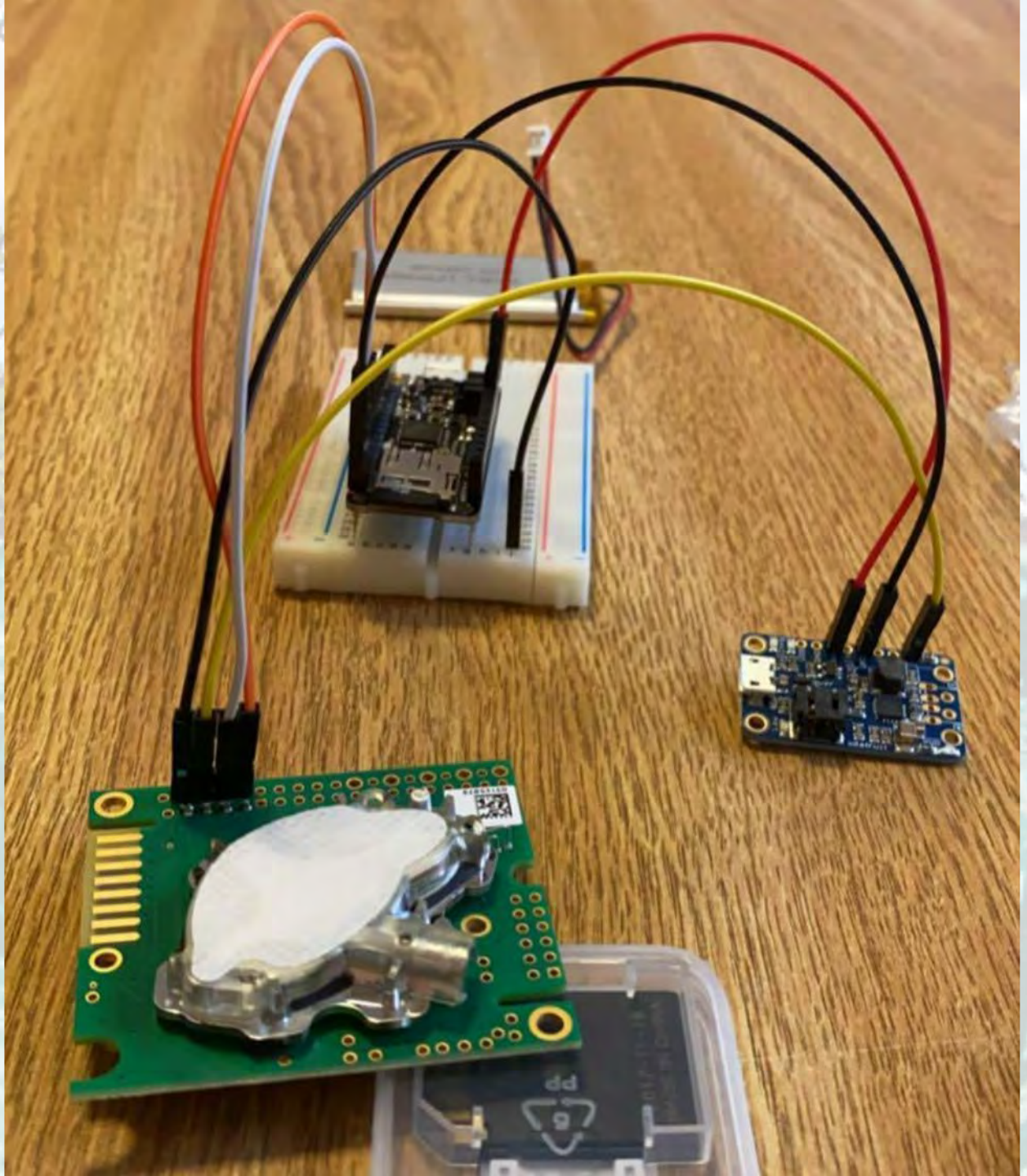


- Increased power for K-30

Common Issues



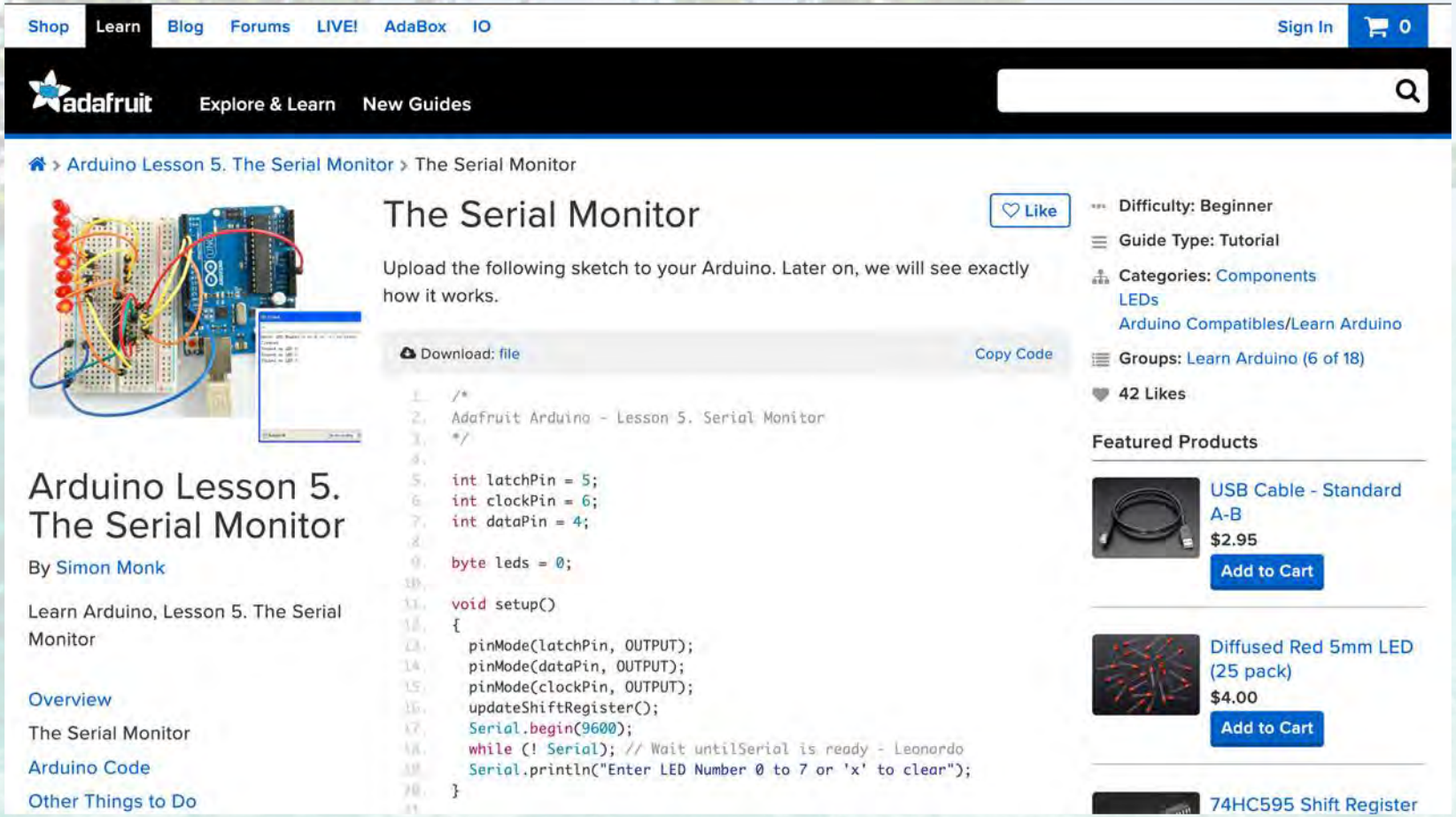
Common Issues



Blinking LED

- Why?

Another option: the Serial Monitor



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?

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

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Power Budget for Oceanographic Sensor

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

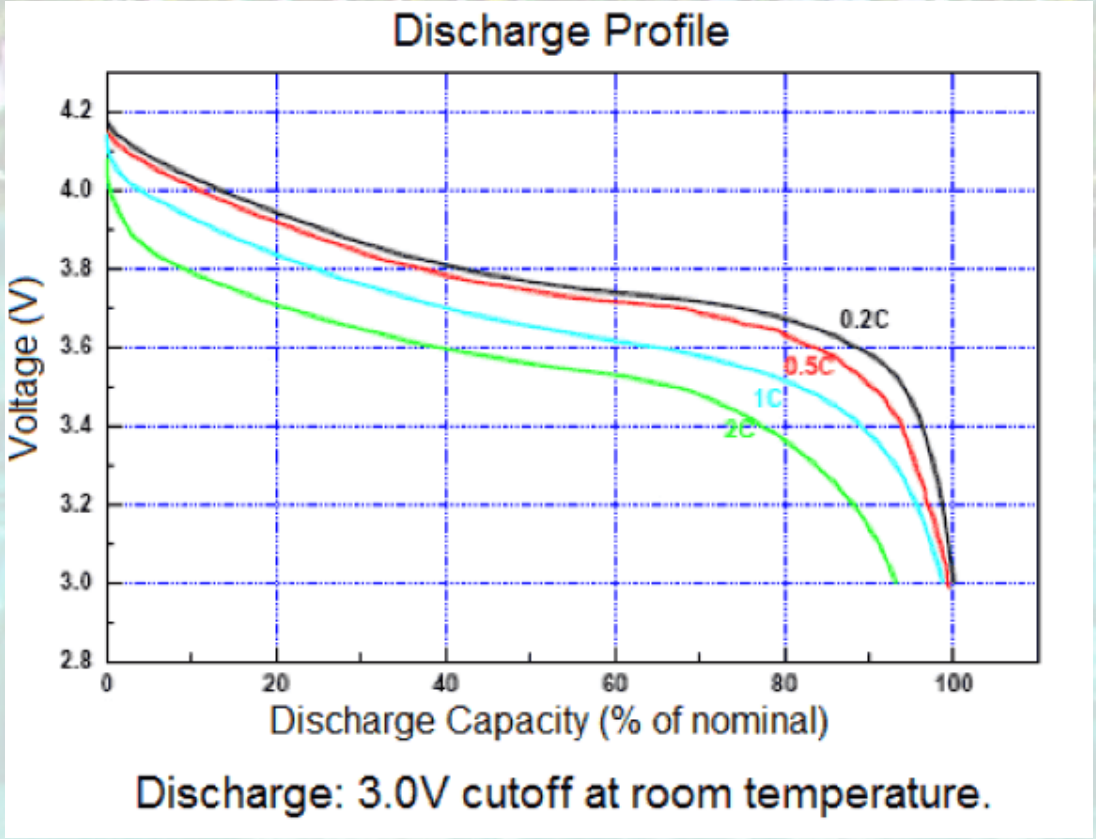
Power Budget for Oceanographic Sensor

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

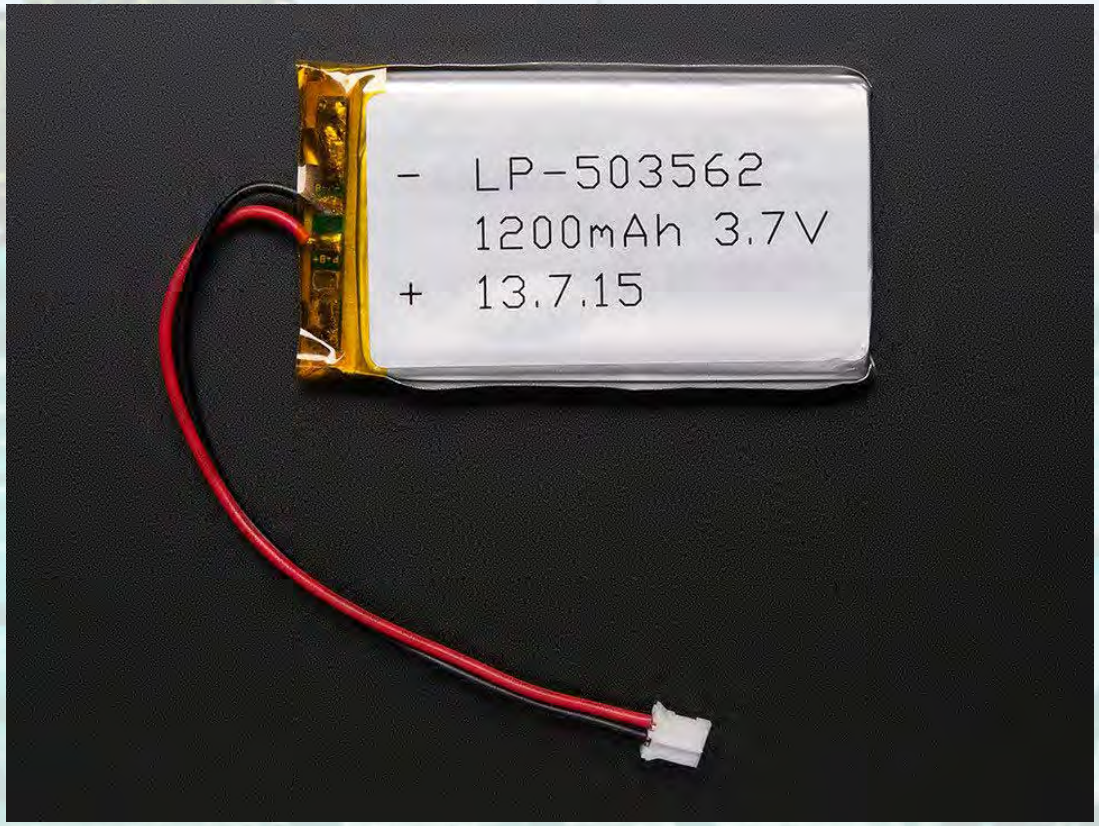
Electrical/Mechanical

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 mA*hr * 3.7 V = 4.44 W*hr
- We will use > 40 mA * 5 V (for K-30; ignore microcontroller for now) = 200 mW = 0.2 W

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- So 4.44 W*hr/0.2 W = 22 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

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

```
Current time    5/22/2019 15:14
First sample    5/22/2019 15:14
Time zone   Local
File name   tanktest.txt
User initials   tw
Sampling period (s) 900
Standard interval   192
Standard multiple   2
pH Sample average   10
Pump on time (s)    10
Valve on time (s)   10
Sample Delay (s)    35
Standard Delay (s)  35
Low battery voltage (V) 10
TCOffset    0
Eo_int_25C  -0.4
Eo_ext_25C  -1.4
Default salinity (ppt)  33.5
Sensor name na
DuraFET SN  na
CAP adapter SN  na
ISE SN  na
MicroCAT SN na
Pump SN na
Pressure sensor full-scale (psi)    100
Vint gain   1
Vint sample rate (sps)  5
Deploy mode (pump on)

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
```

```
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
30  Sample #    Sample Time Main Batt   Vtherm  Vint        Temp pH Temp Pressure (dBar) pH Int      pH Ext  Counter Le
31  #000000 5/22/2019 15:14 15.96   1.1449  0.049919    -1.003      7.639134        6.124978    0   0.3379  5730    15
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33  #000002 5/22/2019 15:45 15.96   1.16591 0.050774    -1.003      7.658213    -0.005629   6.129792    0   0.4149  57
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```

METADATA

COLUMN HEADERS

DATA

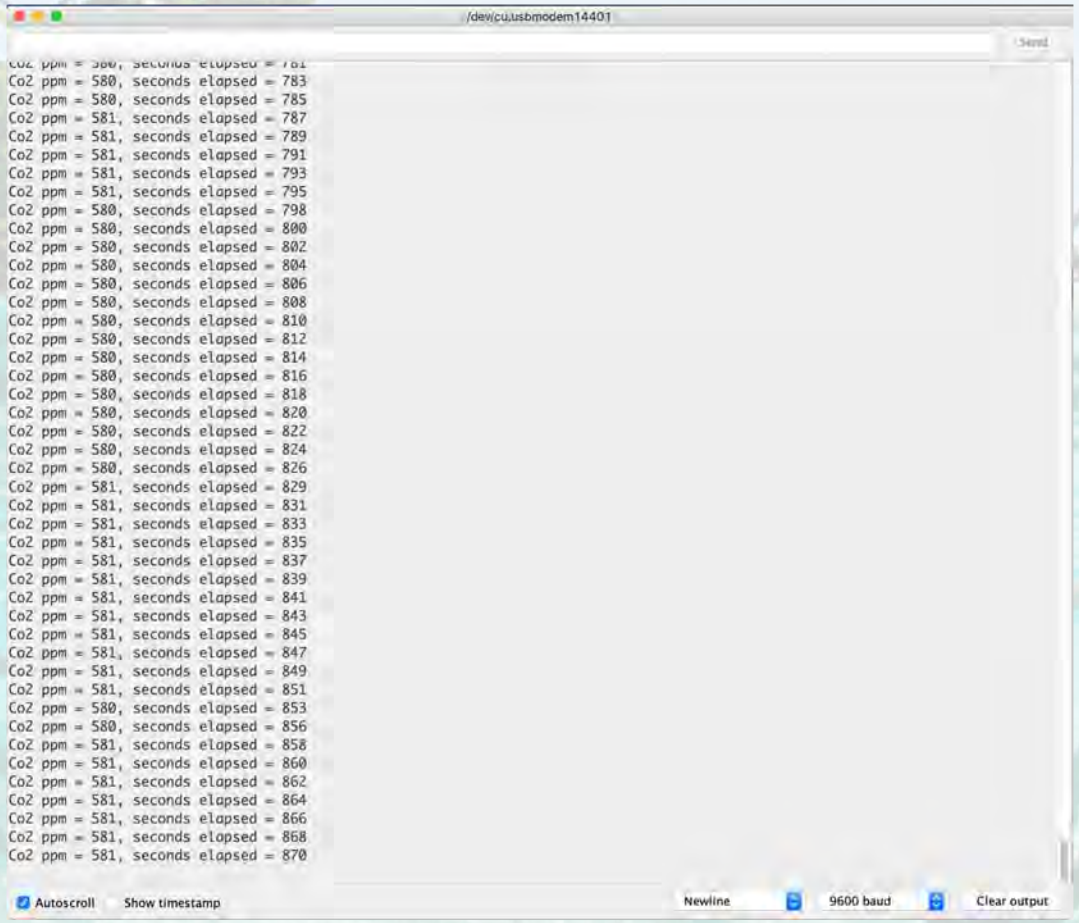
This Week's Assignment

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



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

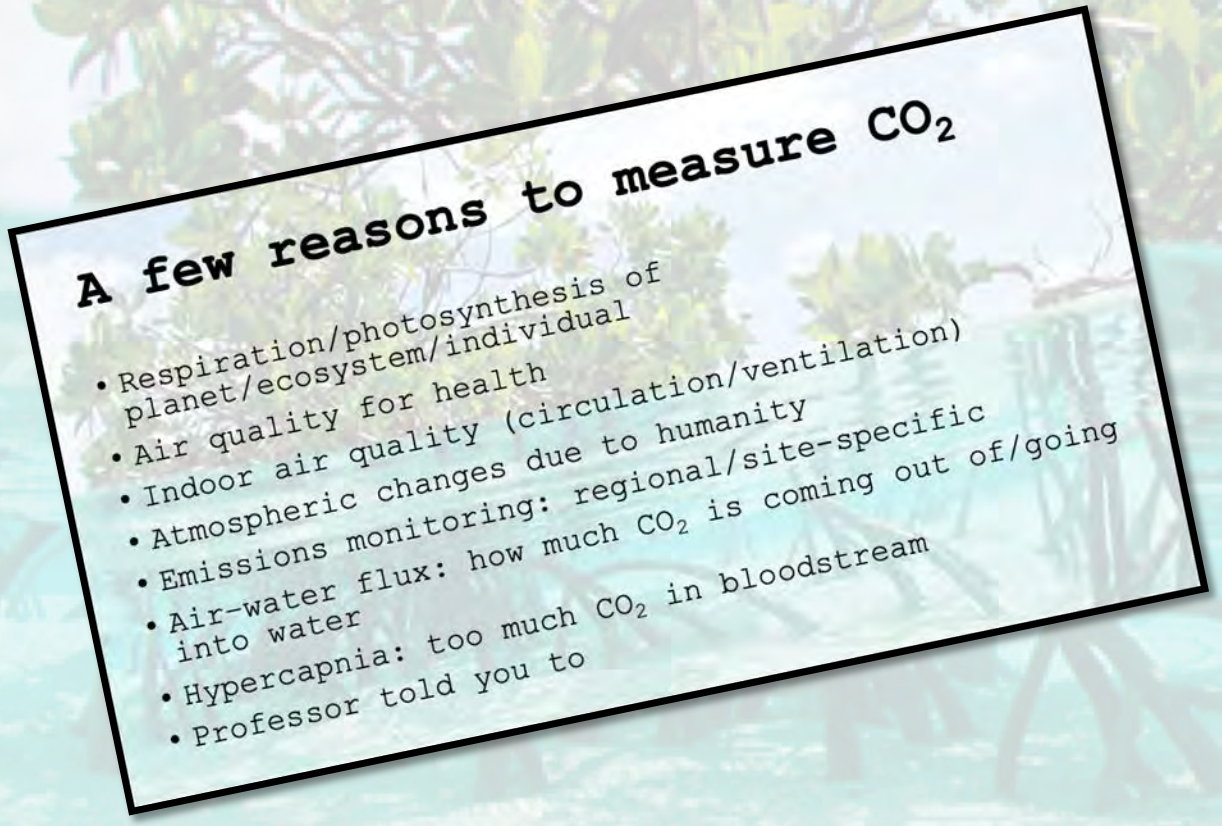
Data

- CO_2 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



- 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.

The Washington Post
Democracy Dies in Darkness

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

Add to list

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

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