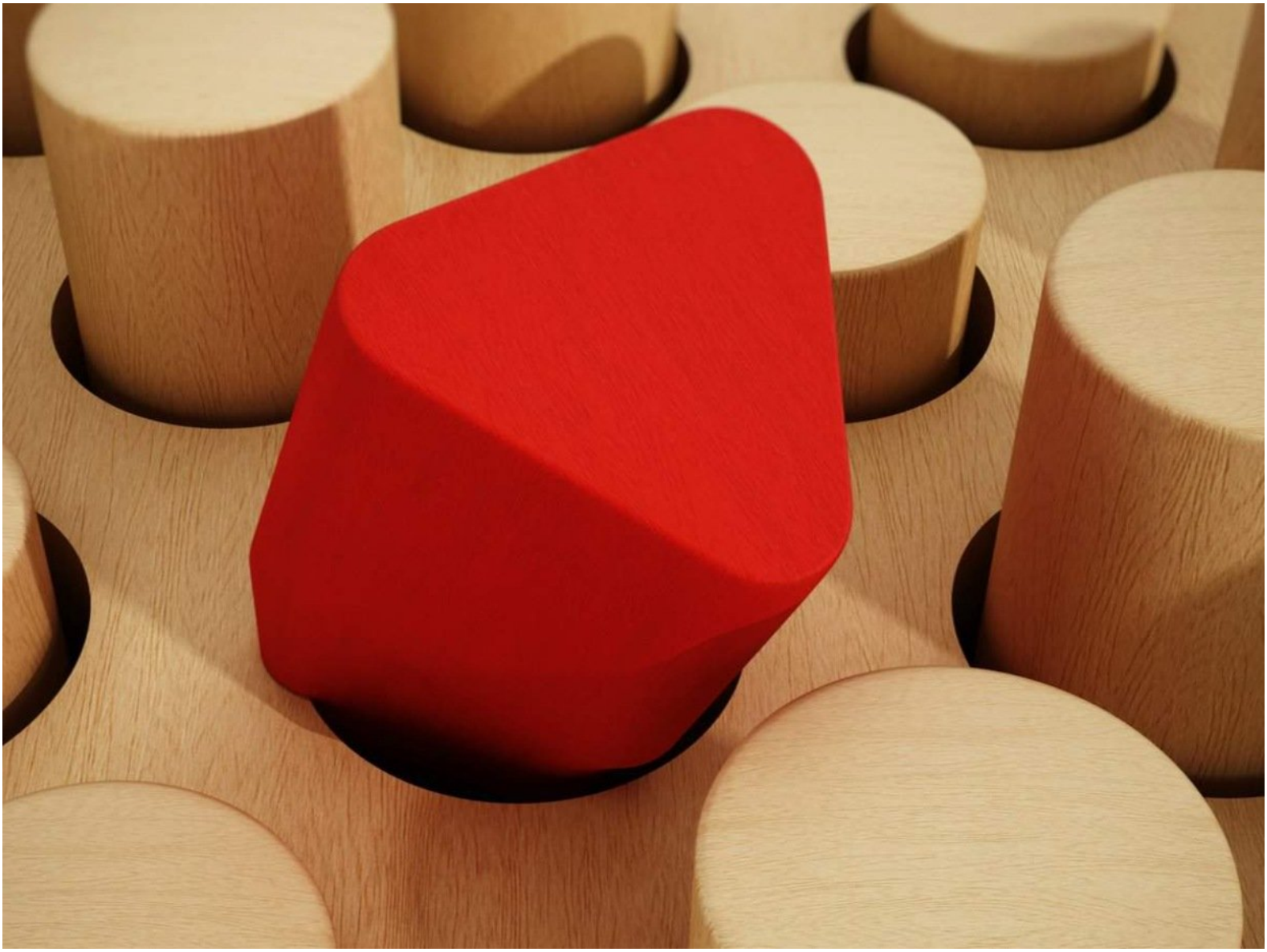
Error-proofing of Depth Sensor Deployments

This guide shows how to aviod problem when deploying sensors in the field. Start this guide after the sensor is already connected to the cell network.

Written By: Gerardo Longoria



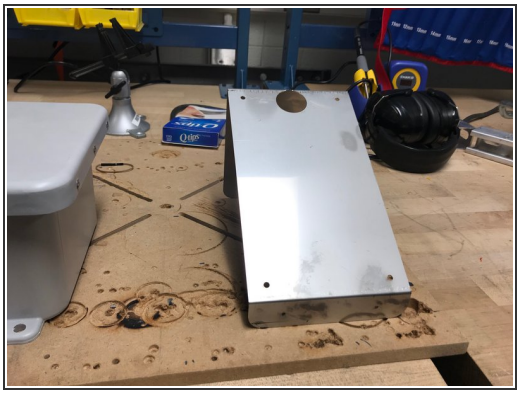
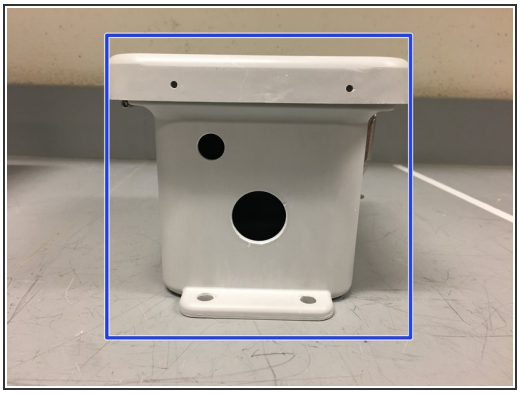
INTRODUCTION

This guide assumes the node is already built. The guide for error-proofing starts on step 19.

PARTS:

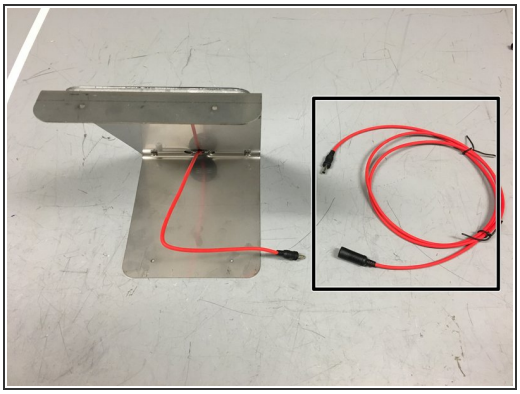
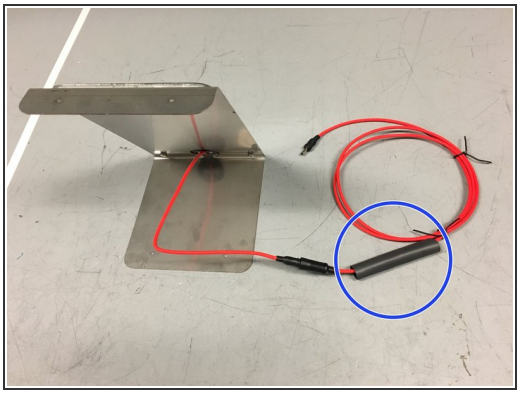
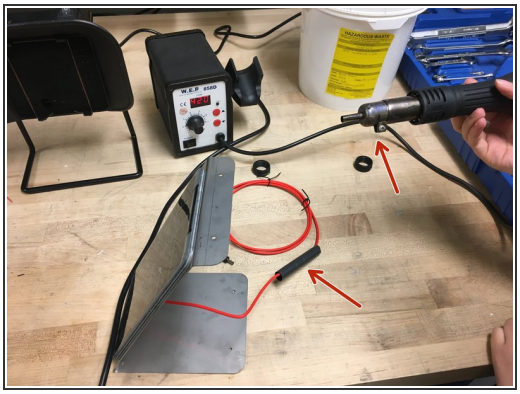
- Enclosure (1)
- Depth Sensor (1)
- motherboard (1)
- Cellular Modem (1)
- Solar Panel (1)
- Solar Panel Frame (1)
- 3.7V Lithium Ion Battery (1)
- Antena (1)
- Jumper pins (2)
- Solar Panel Nuts (4)
- Solar Panel Bolts (4)
- Waterproof Cable Gland Connector (1)
- GPS (1)

Step 1 — Outside Structure

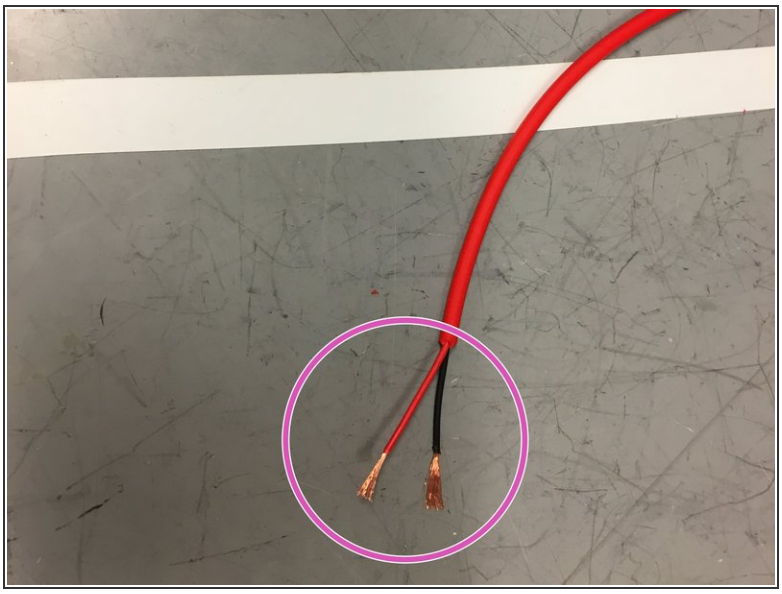
- Obtain a solar panel with the appropriate metal plate.
- Obtain the correctly bend metal plate.
- The enclosure is the box where the sensor board, and wires are kept to protect from the environment.
- Obtain the enclosure with the predrilled holes.

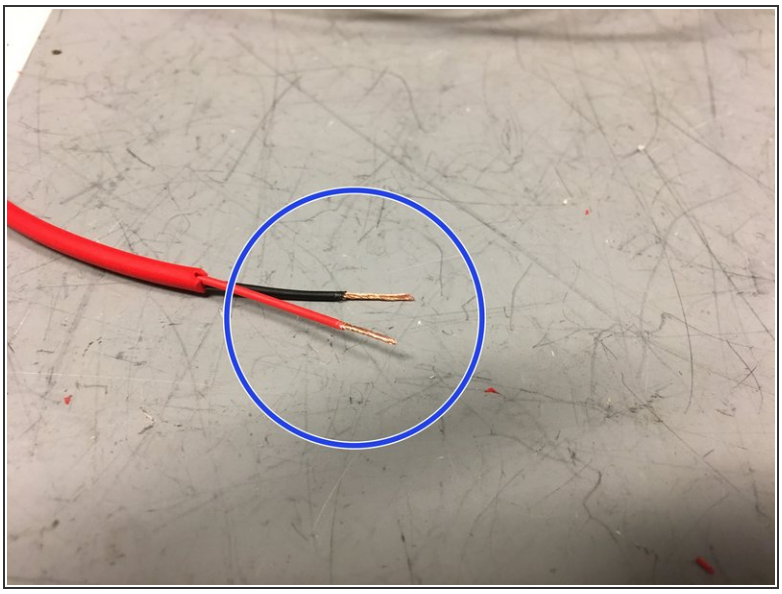
Step 2 — Extending the Solar Panel Wire

- Obtain the solar panel extension cable
- Obtain heat-shrink tubing and place it around the cable
- Cover the connection between the solar panel wire and the extension cable with the heat-shrink tubing. Then, use a heat gun to shrink the tubing, creating a water-tight seal around the connection

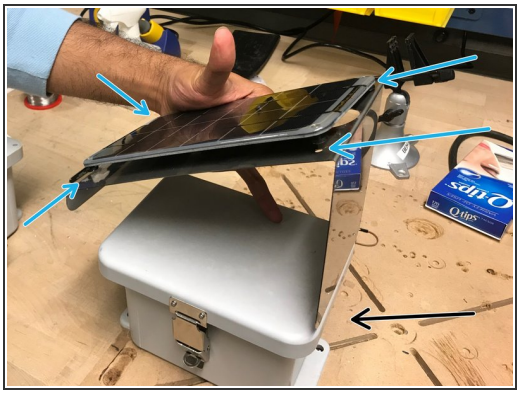
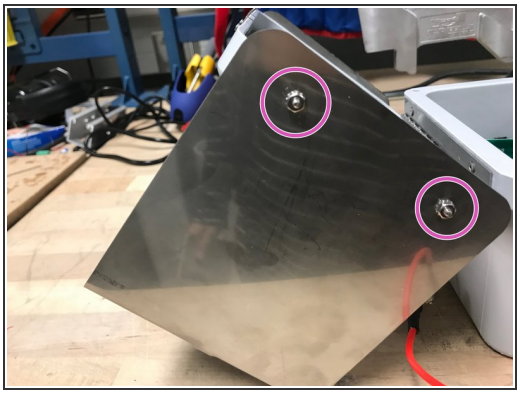
Step 3 — Preparing Solar Panel Wire





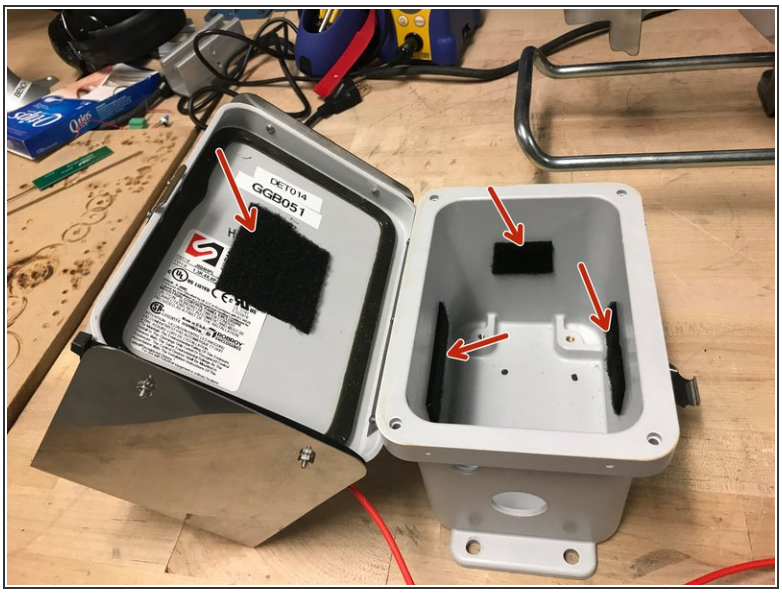
- Trim the solar panel extension wire so there is approximately 20 inches of wire from the connection point
- Strip the wires as shown in the image
- Twist the ends of the wires

Step 4 — Attaching The Solar Panel

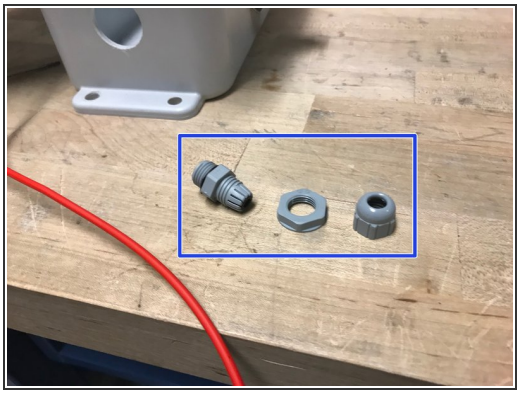
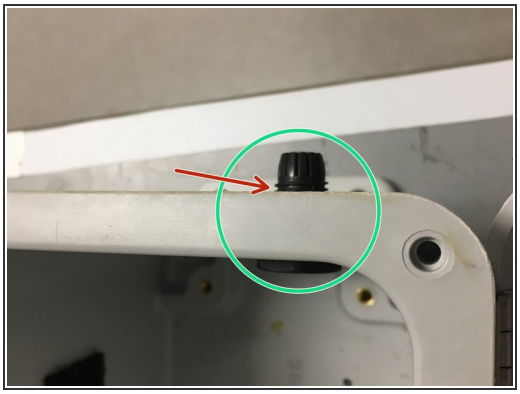
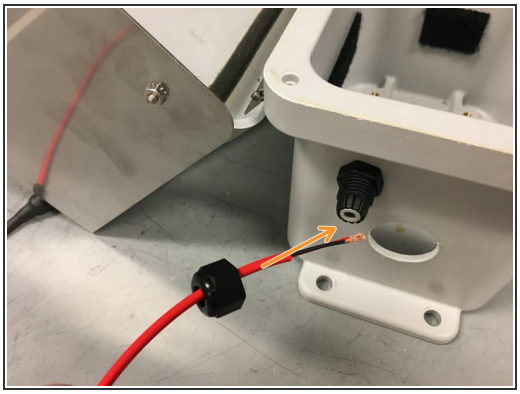
- Attach the solar panel onto the metal plate.
- Using screws and a screw driver, screw the solar panel into these holes. Now that the solar panel is attached to the metal plate, attach the metal plate onto the lid of the enclosure
  - Note: the tall side of the metal plate should be on the same side of the enclosure as the holes for the ultrasonic sensor and cable glands.
- The screws and nuts should be screwed in this matter in the holes on the sides of the box lid (meaning the nut is on the outside)

Step 5 — Adding The Velcro



- Obtain velcro
- Add velcro with soft side inside the enclosure in the following places

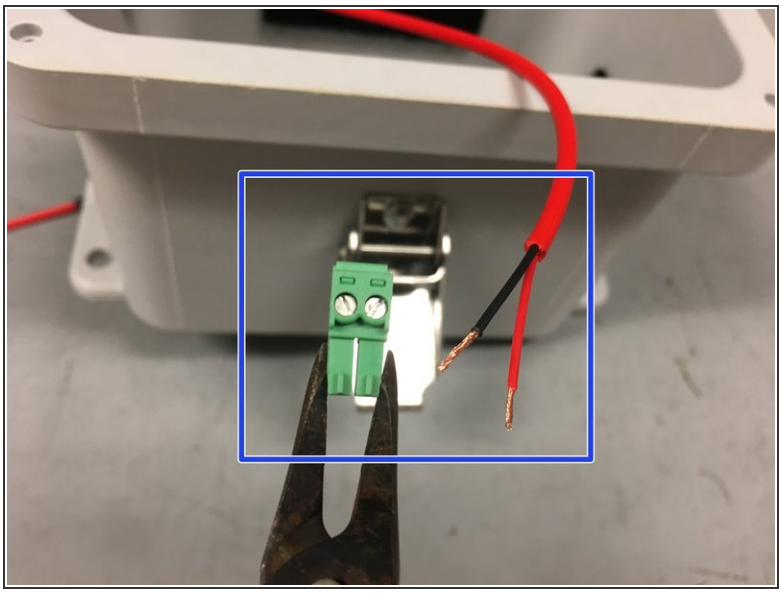
Step 6 — Solar Panel Wire

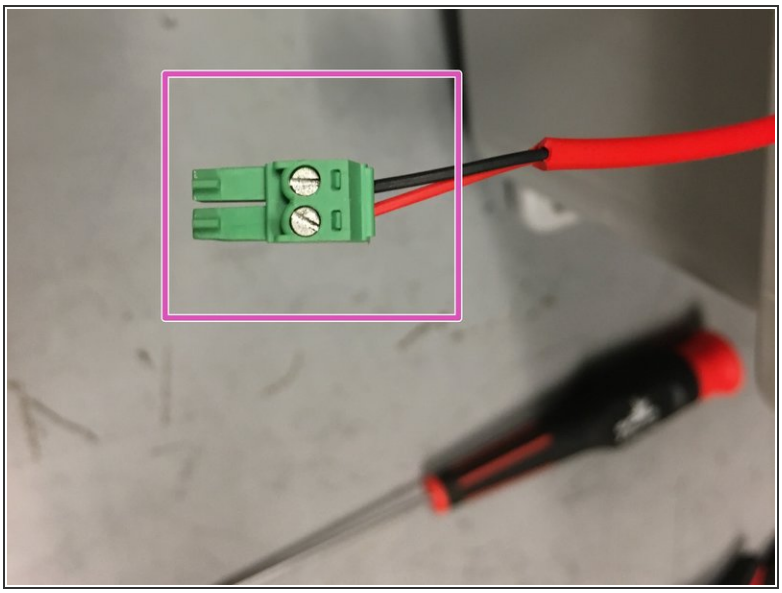




Now we need to insert the red extension wire from the solar panel into the enclosure box

- Obtain a cable gland
- Screw the cable gland into the wall of the enclosure, through the small hole, as shown
- Place an o-ring between the cable gland and outer-wall of the enclosure
- Insert the solar panel extension wire into the cable gland as shown, leaving approximately 8 inches of wire inside the enclosure

Step 7 — Solar Panel Wire Pt. 2

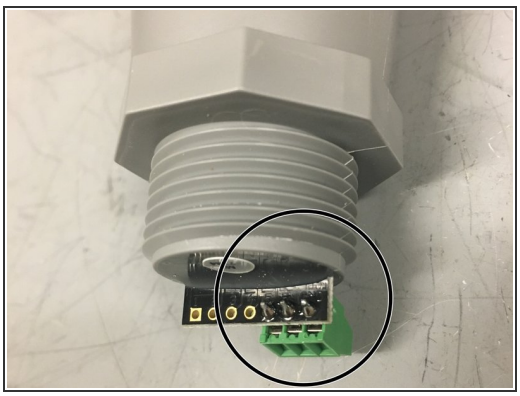


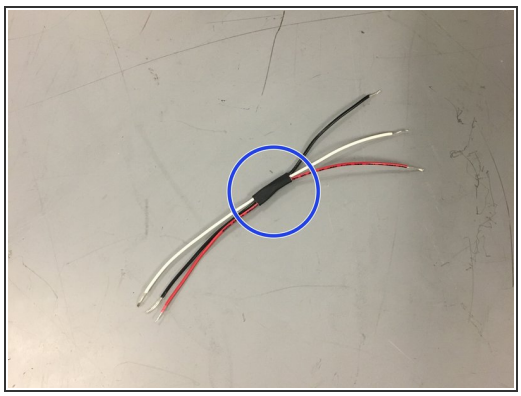


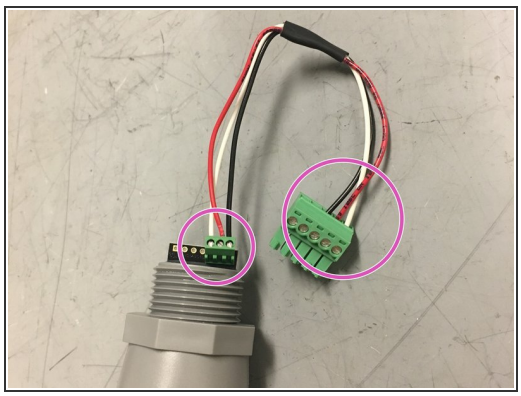
- Obtain a plugable header and ensure the ends of the wires are twisted
- Screw the wires into the plugable header as shown in the picture

Note: hand tight is just right.

Step 8 — Depth Sensor Assembly

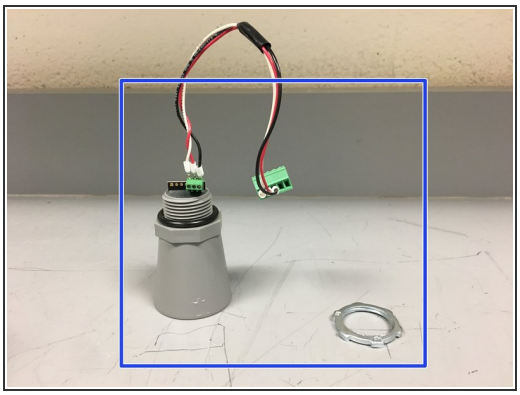
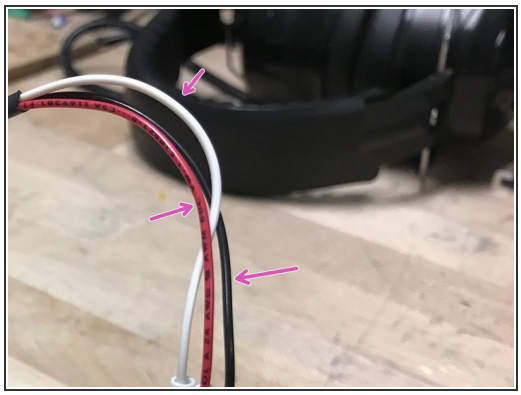
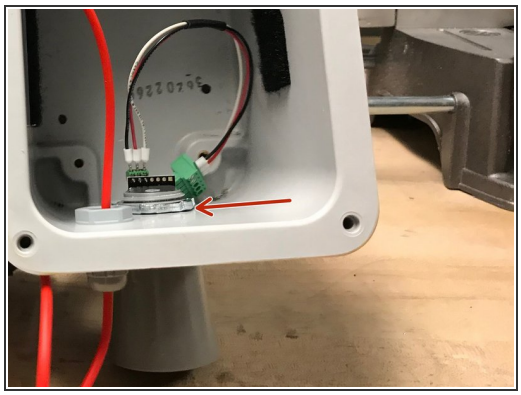






- Solder a 3-prong terminal block to the ground, power, and data (#5) through-holes on the depth sensor
- For organization, bind three wires (red, white, and black) with a small piece of shrink wrap
- Connect the wires as shown in the picture (black to ground, red to power, white for data)

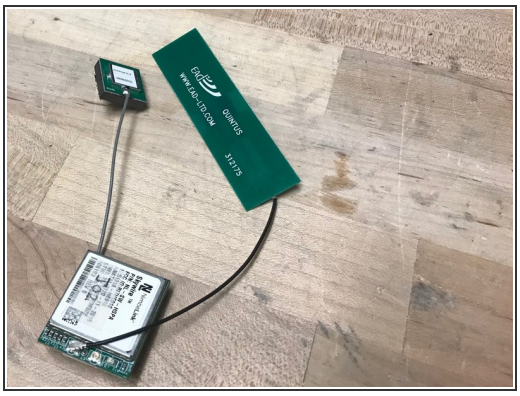
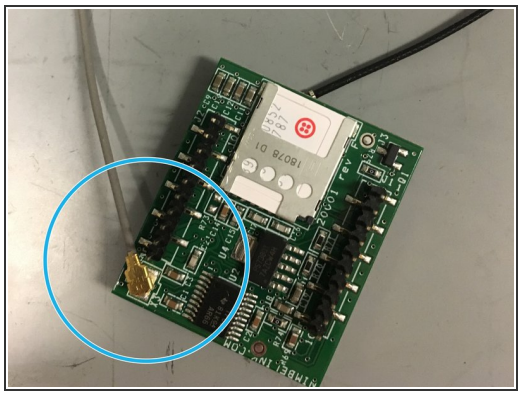
Step 9 — Depth Sensor Installation

- Assemble the depth sensor by adding the o-rings, and the connective wires in the order pictured, leaving the nut ring to the side
- Note that the connective wires connect the depth sensor to the sensor node board. Remember, red wire is responsible for power, black is for ground, and white is for data
- Place the depth sensor through the larger hole, and secure it firmly by tightening the nut ring

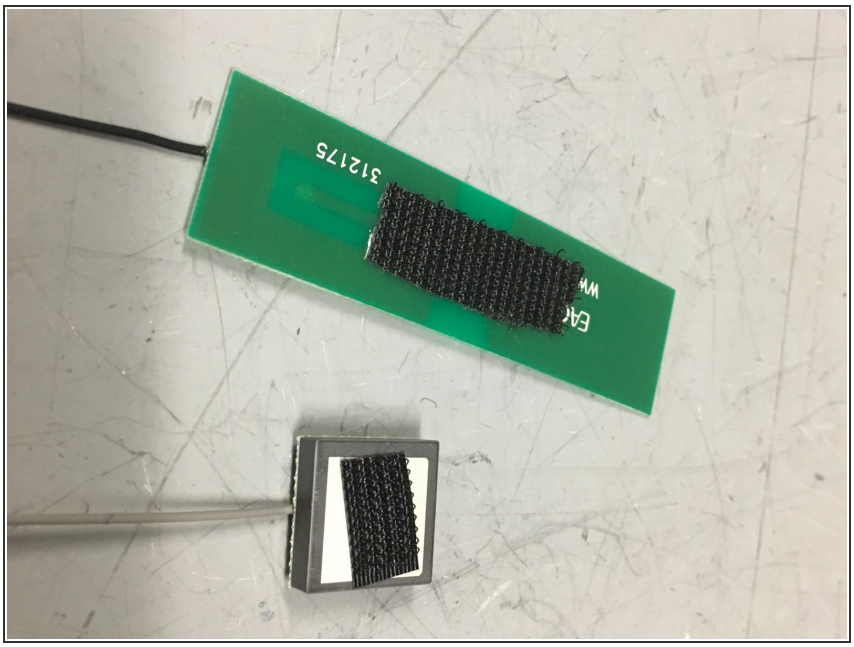
ⓘ Make sure the nut ring is tightened securely as it will keep the enclosure water-tight

Step 10 — Attaching GPS and Antenna to Modem

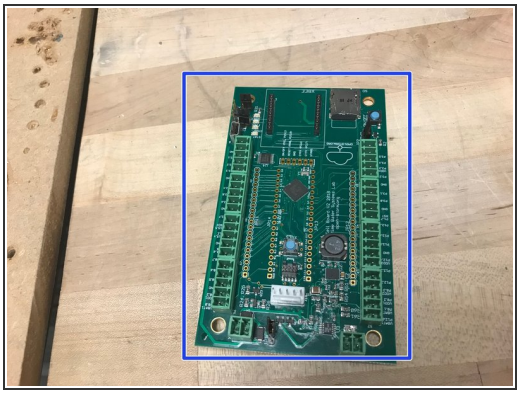

- Obtain the cell module (modem), GPS, and antenna
- Attach the GPS to the connection shown (grey wire)
- Attach the antenna to the connection shown (black wire)

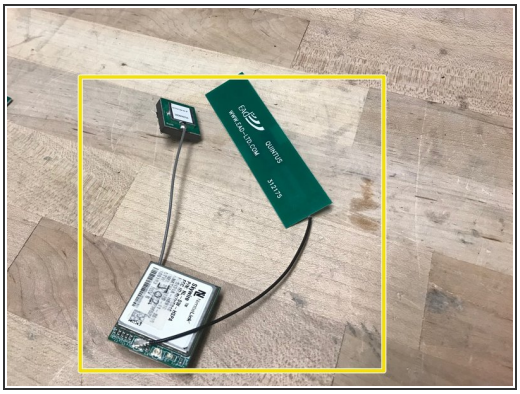
Step 11 — Adding Velcro to GPS and Antenna

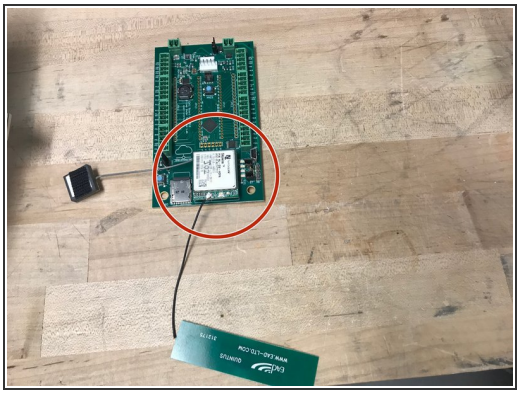


- Attach rough-sided velcro on the antenna and GPS as shown in the picture.

Step 12 — Connecting Modem on Sensor Node Board

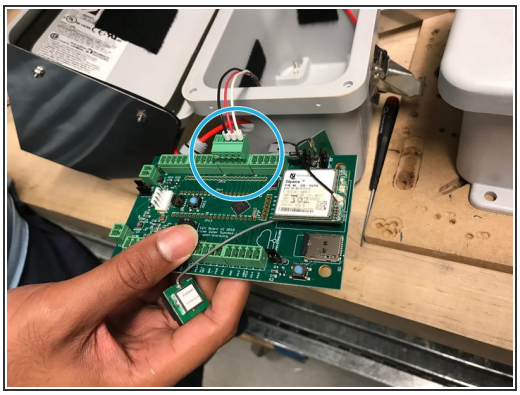
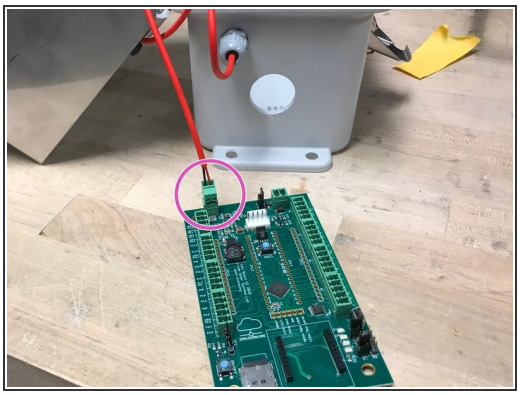
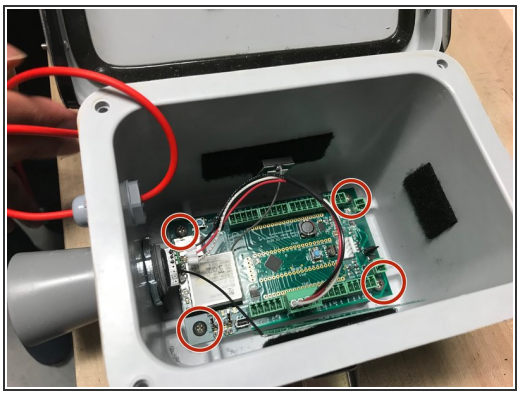






- Obtain Open-Storm board
- Obtain the modem/GPS/antenna
- Attach the cellular module onto the sensor node board in the appropriate place

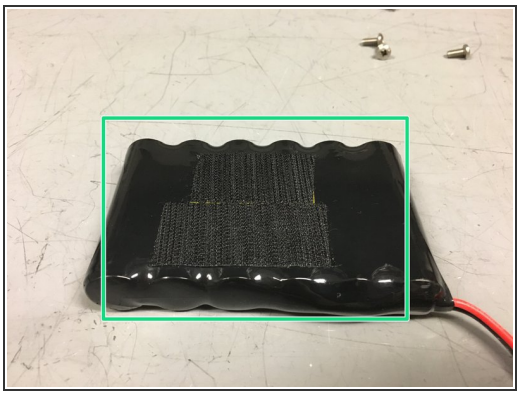
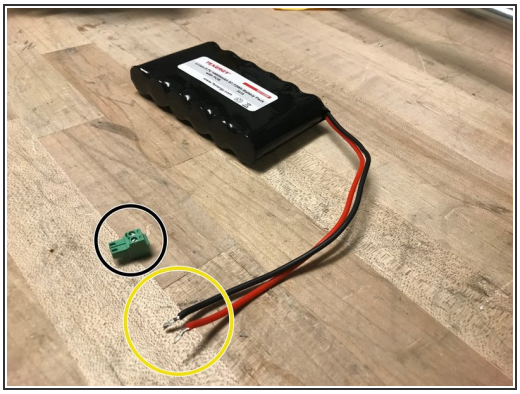
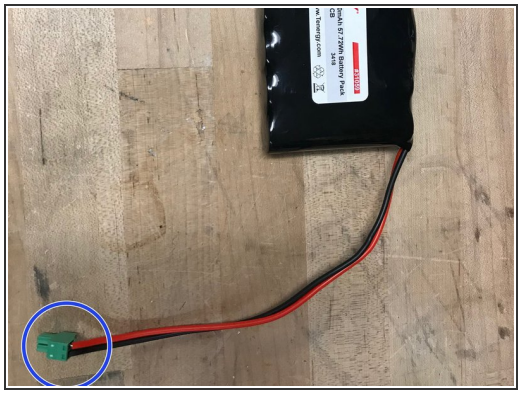
Step 13 — Connecting Sensors, Solar Panel to Node Board

Now the sensor node is attached to the modem, and the depth sensor and solar panel is attached to the box

- Connect the depth sensor wires to any green block (one that fits) on the sensor node
- Connect the solar panel wire to small green block on the sensor node as shown in the picture
- Put the sensor node board in the enclosure box, and screw it in using a screw driver

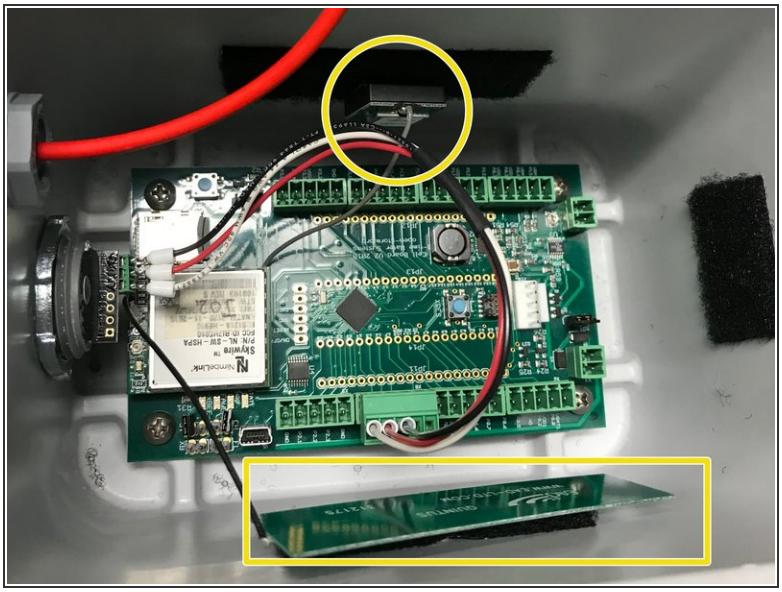
Step 14 — Adding Velcro and Block Plug to Battery

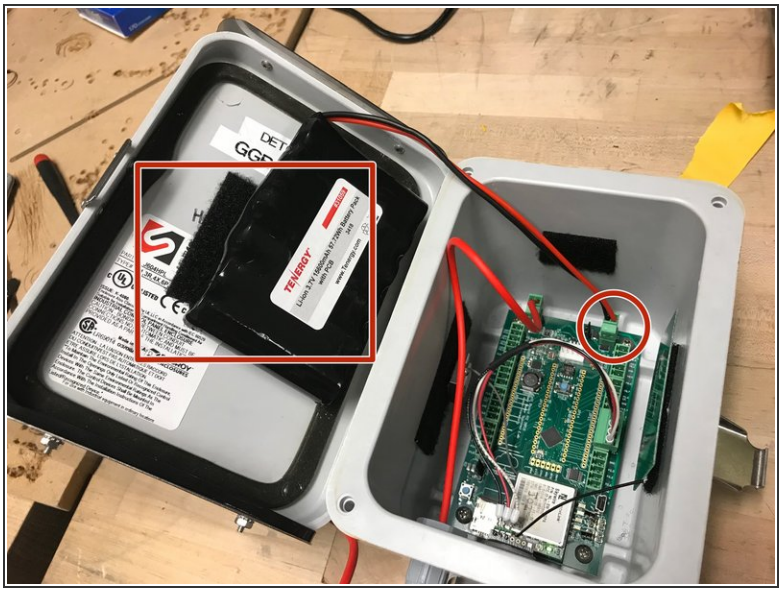




- Obtain velcro and lithium ion 3.7V battery. Attach rough side of velcro on battery
  - ⚠ Be very careful not to short the battery by touching the two wires together.
- Obtain a block plug.
- Twist the wires of the battery so they fit nicely in the plugable-header block
- Screw the wires into the block plug

ⓘ Note: hand tight is just right.

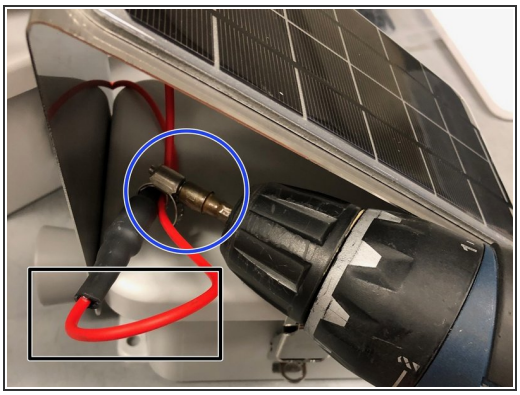
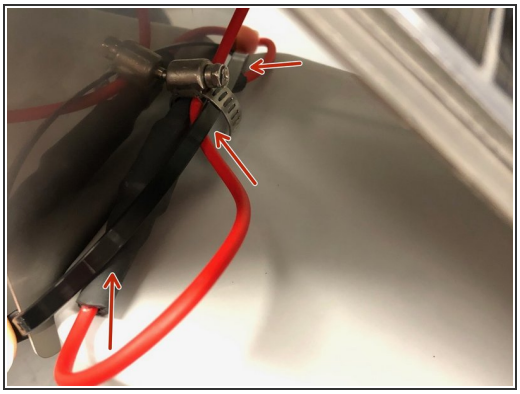
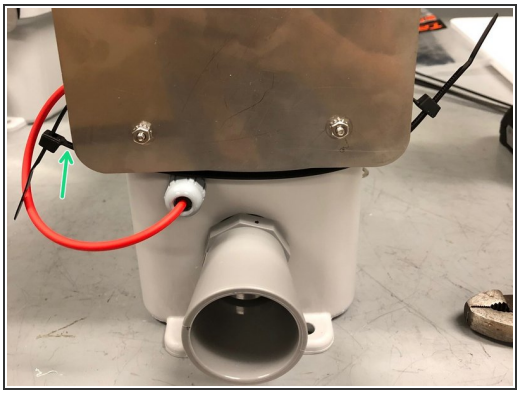
Step 15 — Securing Antenna, GPS, and Battery





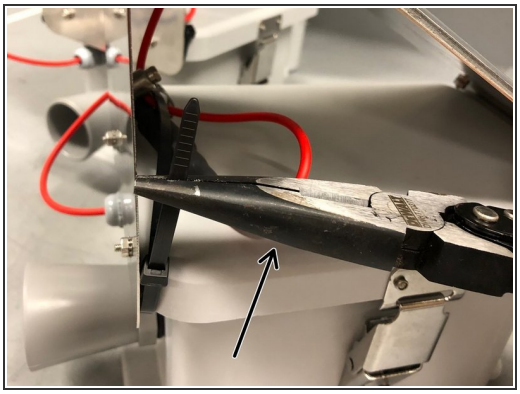
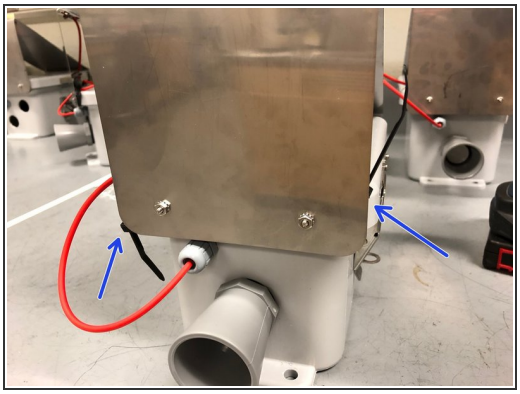
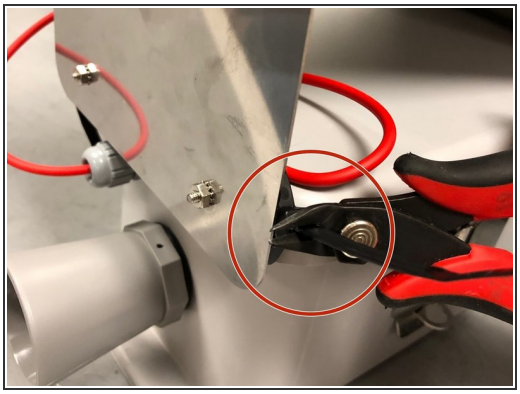
- Attach the antenna, and the GPS on the velcro to the closest wall on the inside of the enclosure
- Attach the battery to the velcro on the inside of the box lid and attach wire to the Open-Storm board

Step 16 — Securing the Solar Panel Wire

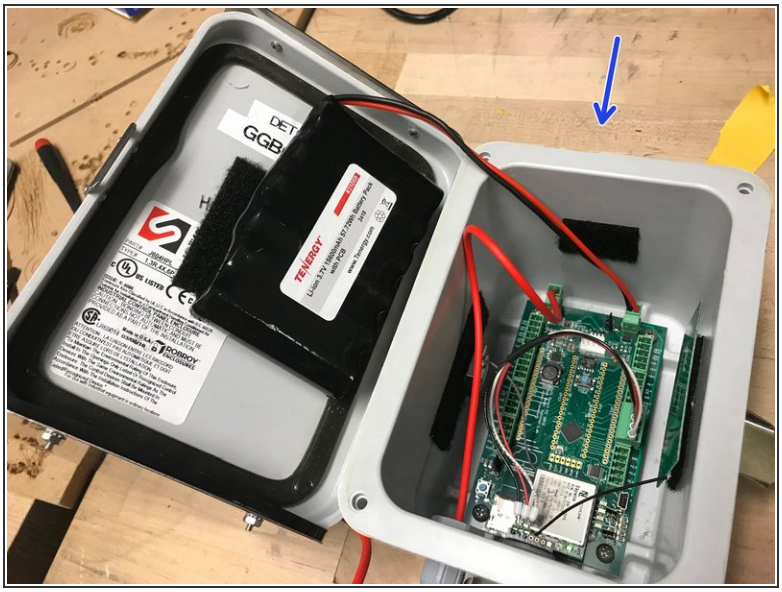
- Fold wire over itself so that the portion above the hose clamp won't have slack when the black wire section is pressed against the inside of the panel
- Obtain a hose clamp, and secure the red part of the wire to the black section using a drill fitted with the drill bit
- Wrap a zip tie around the wire as shown.
- Use a second zip tie to connect the ends of the first one

Step 17 — Securing the Solar Panel Wire-continued

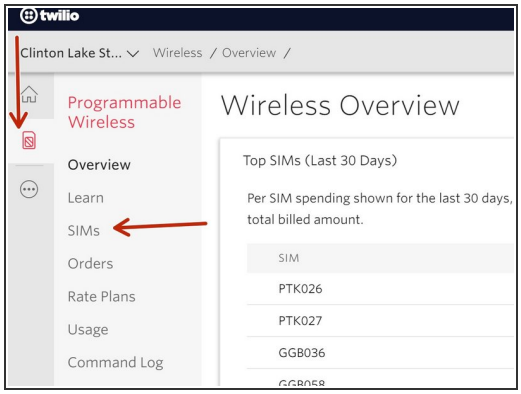
- Use a clamp to tighten the zip tie
- Position each zip tie head as shown while tightening
- Clip excess zip tie as close as possible

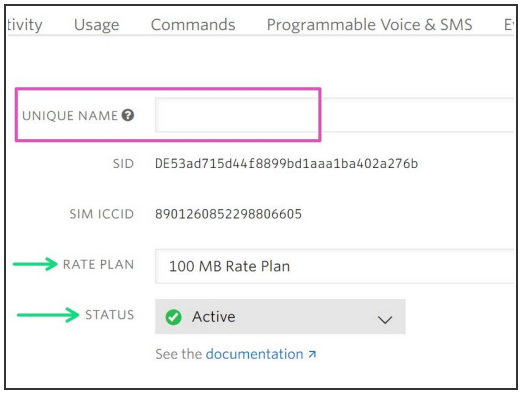
Step 18 — FINISHED!



- This is what the sensor node should look like on the inside
- This is what the sensor node should look like from the outside

Step 19 — Important: Cell Network



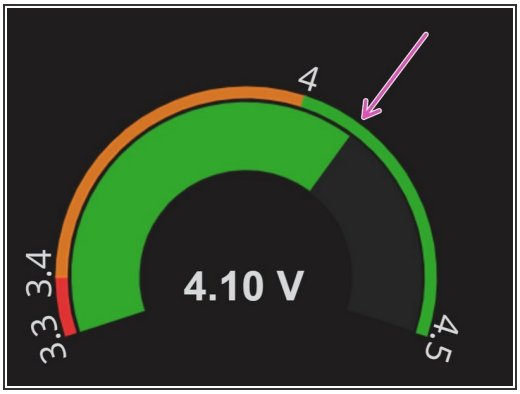


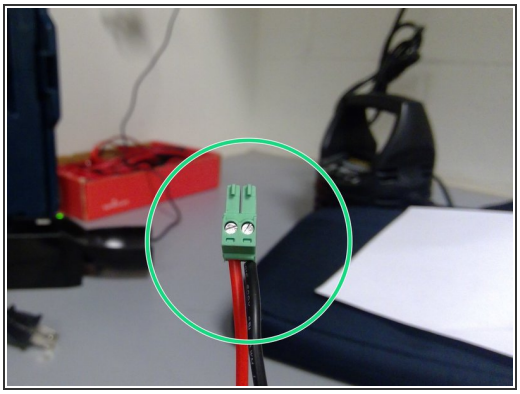
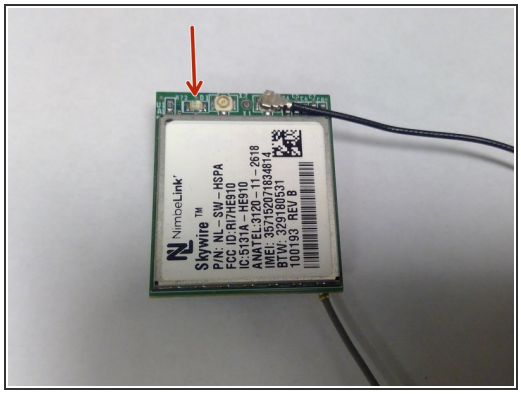
- In-lab: Make sure the sensors node is connected to the cell network. Ask administators to connect it if it's not.

If doing this by yourself then follow the next steps:

- Step1: Check for "Active" on the Twilio website. Use the MEID to search the SIM repositoy on Twilio. If it's active then you are done.
- Step 2: If the search on Twilio did not return anything then check the Node has a SIM card. If yes, then check and update the 'SIM-Node ID pairings' spreadsheet here. If the Node does not have one, get a SIM from an admin and fill in the spreadsheet linked above.
- Step 3: After the node gets a SIM card and the infomation is logged in the 'SIM-Node ID pairings' spreadsheet proceed to activate the SIM card. You will have to log into the Twilio website and activate it. Consult the attached picture to see how the setting should be set.
- Unique Name = Node ID (i.e PTK001). If the Node ID is already taken then doulbe check the ID parings here. If it's all good, then edit all the Twilio unique names accordingly.

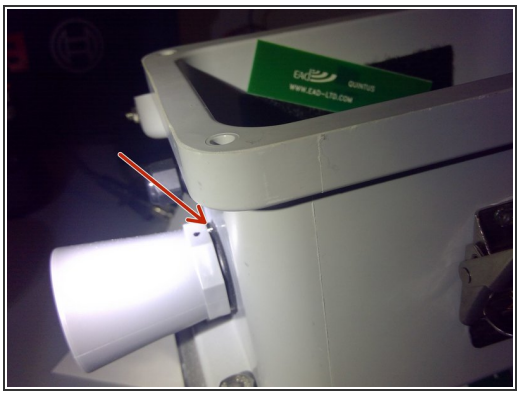
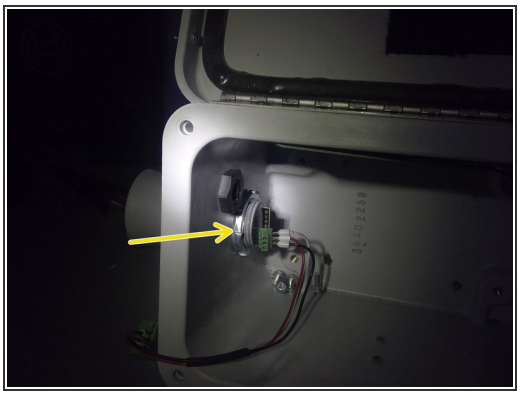
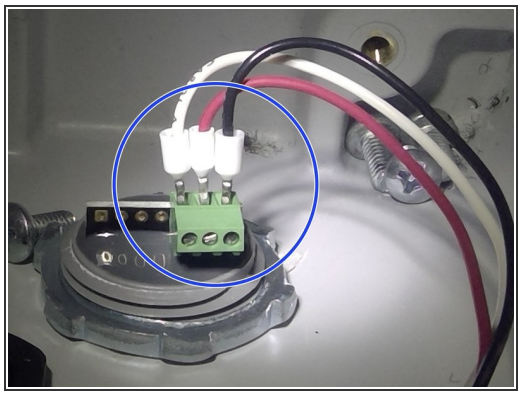
Step 20 — In-lab step: Power



- Insert a fully charged battery into the sensor node. Plug in the battery before the solar charger.
- Make sure the battery leads are wired correctly. The terminal block and leads are shown here.
- A green LED light on the cell modulem should turn on.

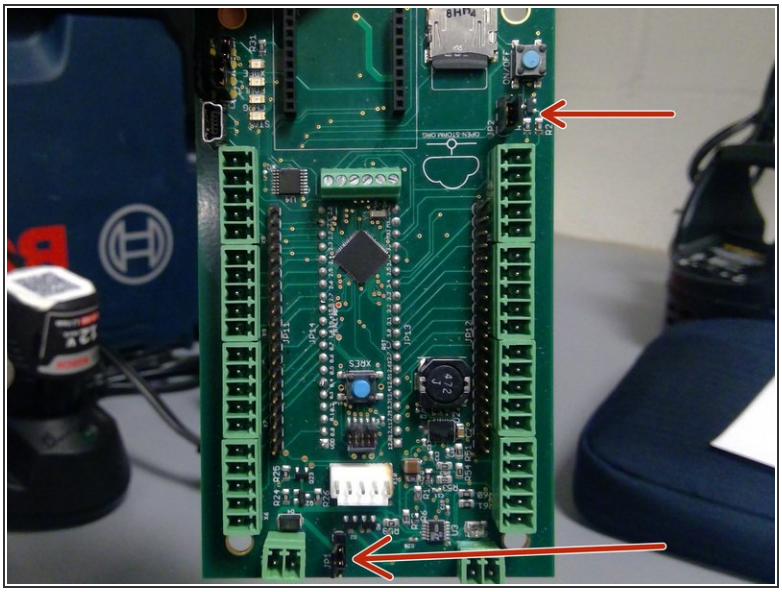
Step 21 — In-lab step: Ultrasonic Sensor

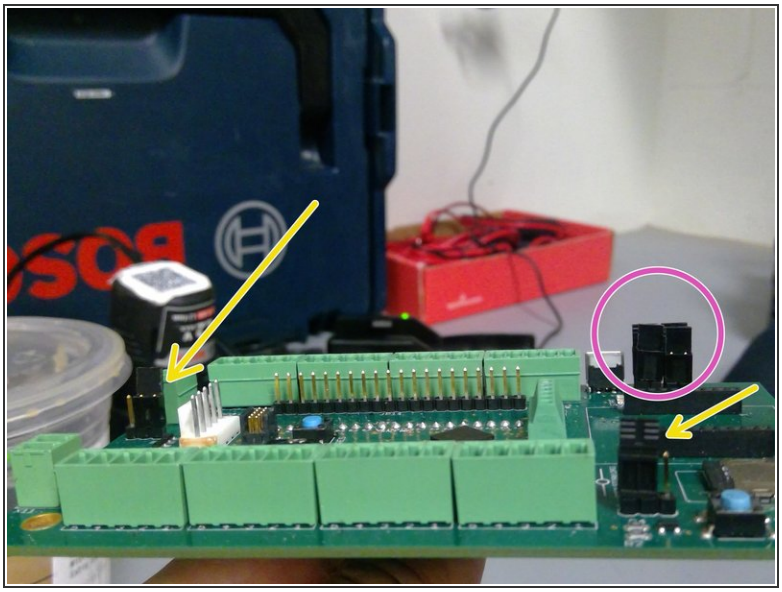




- Make sure that there is an O-ring on outside of the node.
- make sure to tighten the screw on the inside snuggly.
- Make sure the wires are connected in this manner. From the edge it should be "black, red, white". The ultrasonic sensor has labels on it and GND (ground) is on the very end. Hence, the black wire on the end.

The other ends of the wires are connected to a 5-prong terminal block. That terminal block should be connected to the board at the following pins: P12.3 : White wire, P12.4 : Red wire, GND : Black wire.

Step 22 — In-lab: Board jumpers





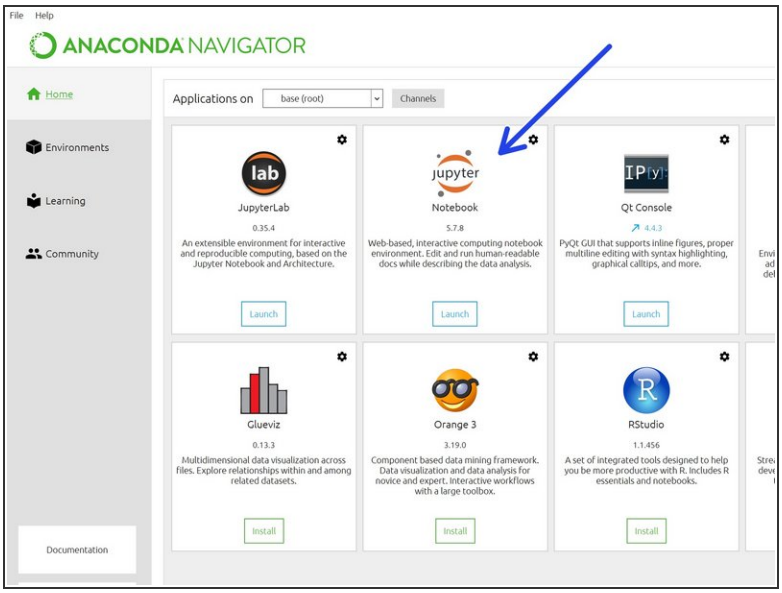
- Make sure all the jumpers on the board are connected properly. They are labeled JP1 and JP2

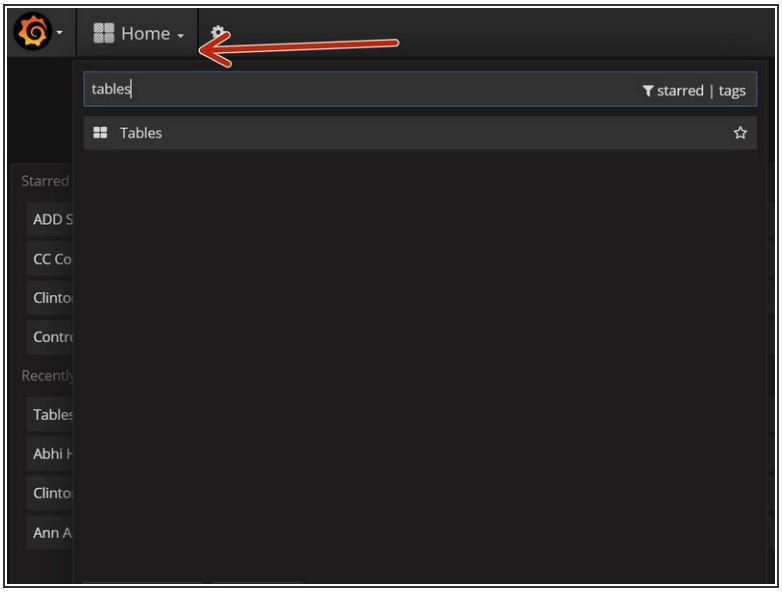
can use the mnemonic "top-down, bottom-up".

- Another view.

- These jumpers should be disconnected when ready to deploy. This is done to save battery.

Step 23 — In-lab step: Assign the node ID and Reporting Frequency





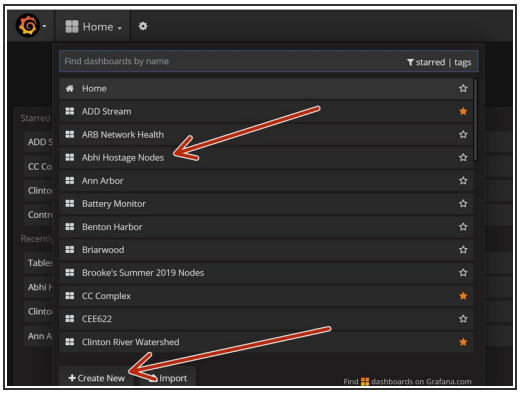
The Node ID is determine by the location where the node will be deployed. Ask and administator where to deploy. Then, find all the site details here.These include site visits, pictures, addresses, and notes.

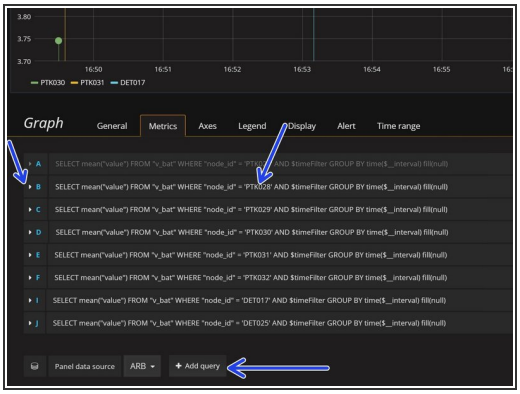
- Ask admin to do this step. Alternatively, ask admin for the scripts that assigns the Node ID and the reporting time interval. Assign both using the Anaconda Navigator's Jupyter Notebook feature. You will need the sim card's MEID and the desired Node ID to do this. The google drive has a spreadsheet with MEID's and Node ID's here. Keep this updated.

Set the reporting frequency to 5 minutes!

- Once assigned, the readings will be pushed to Grafana. To double check that it was assigned successfully you can consult the 'Tables' Dashboard on Grafana. Ask administarator for Grafana credentials.

Step 24 — In-lab: Set up a Grafana Dashboard

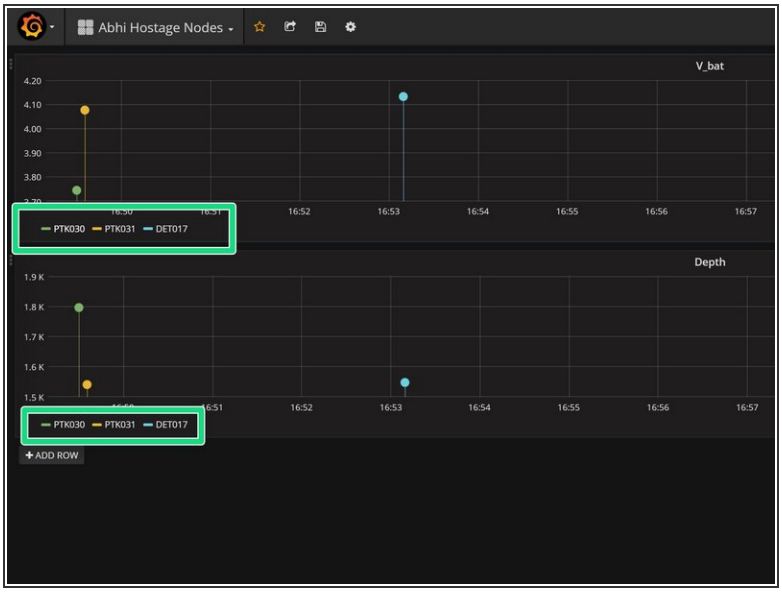


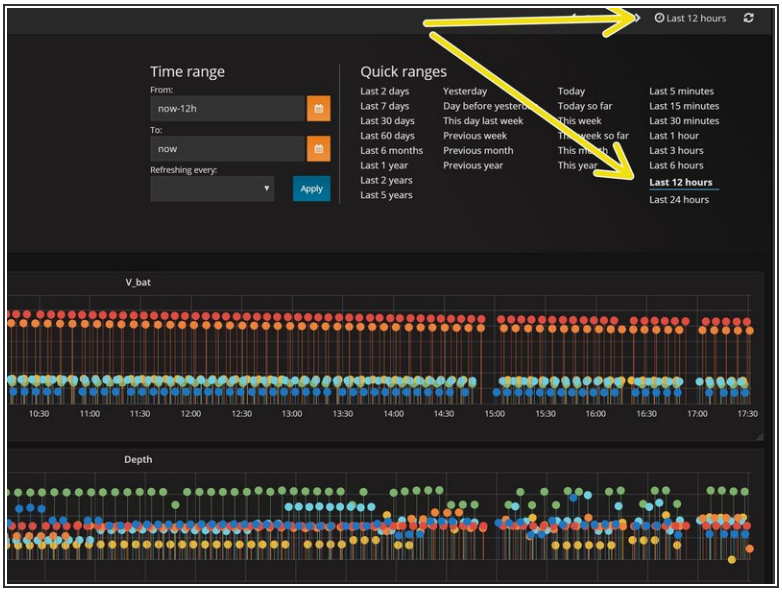


Assumption: you have the Grafana credentials.

- Use an existing Dashboard (i.e. Abhis Hostage Nodes) or create one.
- To enter the edit panel click the header and it will appear. If you created a new dashboard, then you must create a 'v_bat' panel and a 'maxbotix_depth' panel. They should be labeled to indicate battery voltage and depth. Always save changes frequently.
- Once inside the edit panel: It's possible to edit an already existing entry and only update the Node ID and alias. Alternatively can click on 'add query'. When adding a new query get an admin to supervise while you do it.
- Use this dashboard exclusively for testing and delete already deployed nodes. Sensors that have been deployed should be promoted to their permanent Grafana Dashboard. i.e: Cinton River, Huron River,...

Step 25 — In-lab step: Observe the readings





- Click on the nodes INDIVIDUALLY to see that the reported values are sensible. If the depth reading is -1 then there is an ultrasonic sensor problem. If the depth value is 0, then the ultrasonic sensor does not have 0.5 meters of required space between itself and what it's reading.
- Node must report successfully for 12 hours
- Bring at least 1 extra working nodes when deploying!

Step 26 — In-lab step: Plan the next days route

- Find the address by viewing the site visit documetation here. Read the notes about the potential hazards and where to park.
- prepare emergency phone numbers and note the closest urgent care.
- Choose nodes that are close near each other. Use Google Maps 'add-a-stop' feature to check proximity.

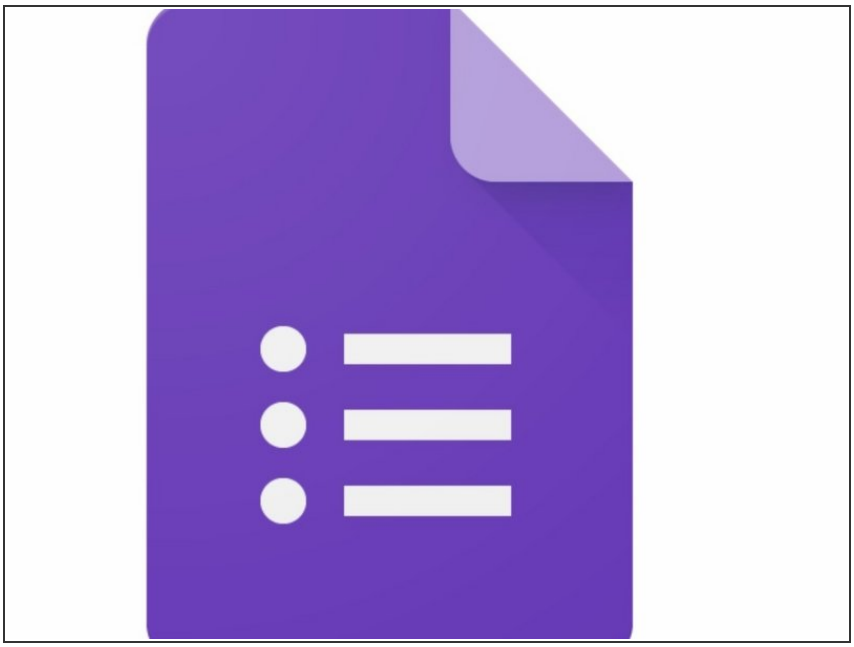
Step 27 — In-lab step: Prepare the van

- Make sure to take all required tools. The tools required should be deduced from the site visit inspection and notes corresponding to the location.
- The van already has a tool kit. The google drive has a document specifying which tools belong in the van.
- Collect hardwarespecific to sites, enough fully charged batteries for nodes, at least one fully charged 12v battery, enough locks, and drinking water.

ⓘ Hardware inlcude strut channel, bolts, nuts, brackets, C-clamps, etc.

- Pump gas here.

Step 28 — On-site step: Documentation



- Upon ARRIVING to every site, fill this google form.
- Upon LEAVING every site, fill this google form.

Step 29 — On-site step: What to do if theres a problem

- After the node is deployed and there is no interference from it being hadled, wait for a reading.

ⓘ The reporting frequency should have been set to 5 minutes! As required in step 21 of this guide.

- If the reading doesn't appear or it's -1, then reach out to someone in lab to reassign a working node to that location. Take the faulty node back to lab. Donnot diagnose in the field.

ⓘ Assumption: You brought extra working nodes.

ⓘ Requirement: Bring extra nodes.