OPEN SOURCE SENSOR HARDWARE OVERVIEW

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OPEN SOURCE SENSORS/ELECTRONICS

- What does it mean to be open source?

- Creative Commons

- Online community

- Reproducible and adaptable technology
  - Can recreate (PCB schematics)
  - Modify for unique purposes

WHAT IS ARDUINO?

- Open-source electronics platform
- Hardware:
  - Inexpensive microcontrollers
- Software:
  - Interactive Development Environment (IDE)
  - Simplified programming, C++ compatible
- Diverse applications:
  - Robotics, music, tech prototyping, scientific equipment, teaching, aquaculture, hydroponics, etc.

HARDWARE SELECTION CRITERIA

- Low cost

- Compatibility with Arduino microcontrollers

- As "plug and play" as possible…

- *Mention of trade names or commercial products does not constitute endorsement or recommendation for use*

ARDUINO MEGA 2560 REV3

Microcontroller	Atmega2560	ATmega328P
Operating Voltage	5V	5V
Input Voltage	7-12V	7-12V
Input Voltage Limit	6-20V	6-20V
Digital I/O Pins	54	14
PWM Output Pins	15	6
Analog Input Pins	16	6
I/O Pin DC Current	20mA	20mA
3.3V Pin DC Current	50mA	50mA
Flash Memory	256 KB	32 KB
SRAM	8 KB	2 KB
EEPROM	4 KB	1 KB
Clock Speed	16 MHz	16 MHz

ARDUINO MEGA 2560 LAYOUT
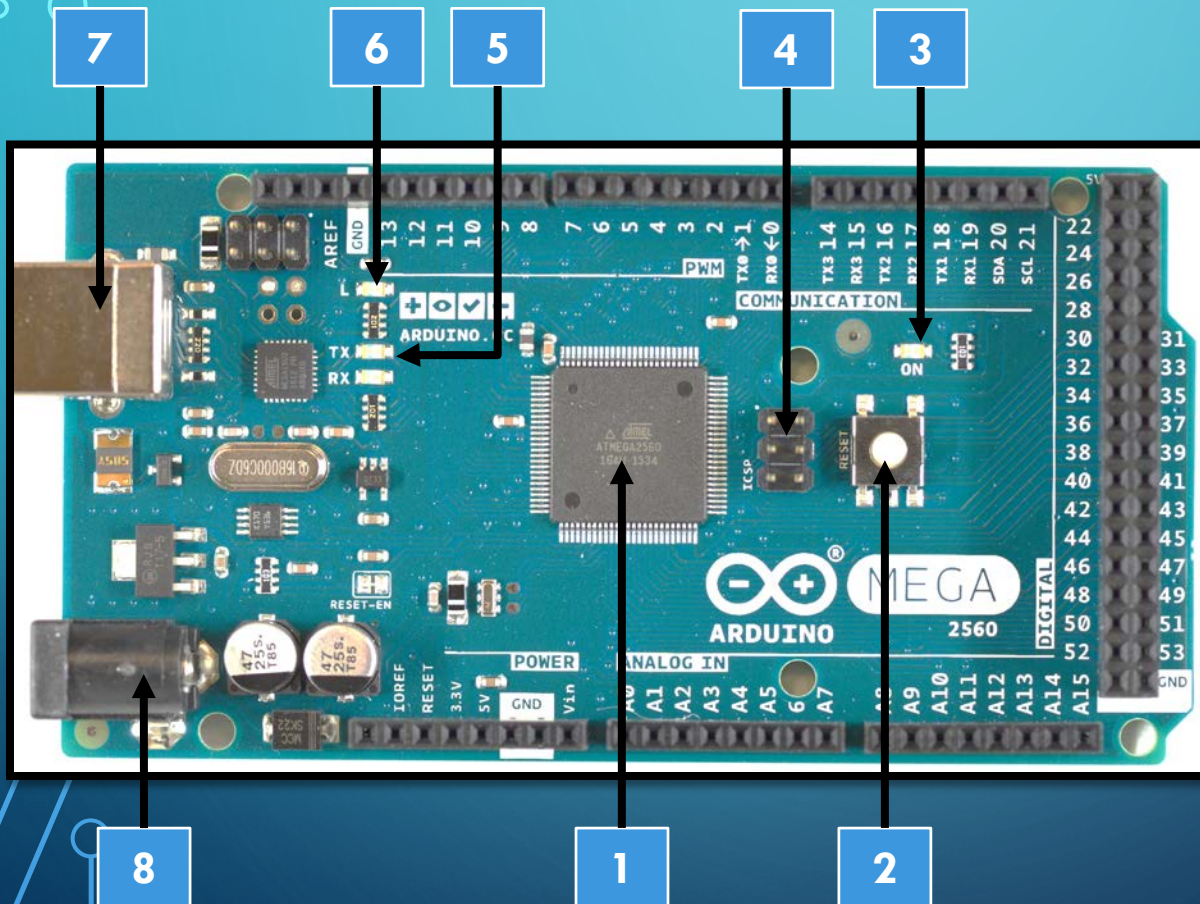
#	Component
1	ATMEGA2560 Chip
2	System Reset
3	Power Indicator LED
4	SPI Pins for data logger
5	Transmit/Receive LEDs
6	Programmable LED
7	USB Power/Serial coms
8	7-12 Volt DC Input

ATLAS SCIENTIFIC PROBES

- Temperature, conductivity, pH, and dissolved oxygen

- Analog probes

- Co-axle cables with BNC connecters

- 10 meter BNC extension cables

TEMPERATURE PROBE (THERMISTOR)

- Range: -200°C to 850°C
- Accuracy: +/- (0.15+0.002*T)
  - +/- 0.2°C at 25°C
  - +/- 0.35°C at 100°C
- Reaction Time: 90% in 13s
- Life Expectancy: ~15 years
- Type: Class A Platinum

pH PROBE

- Range: 0-14

- Max Depth: 60 meters

- Temp Range: 1-99°C

- Response Time: 95% in 1s

- Life Expectancy: ~2.5 years

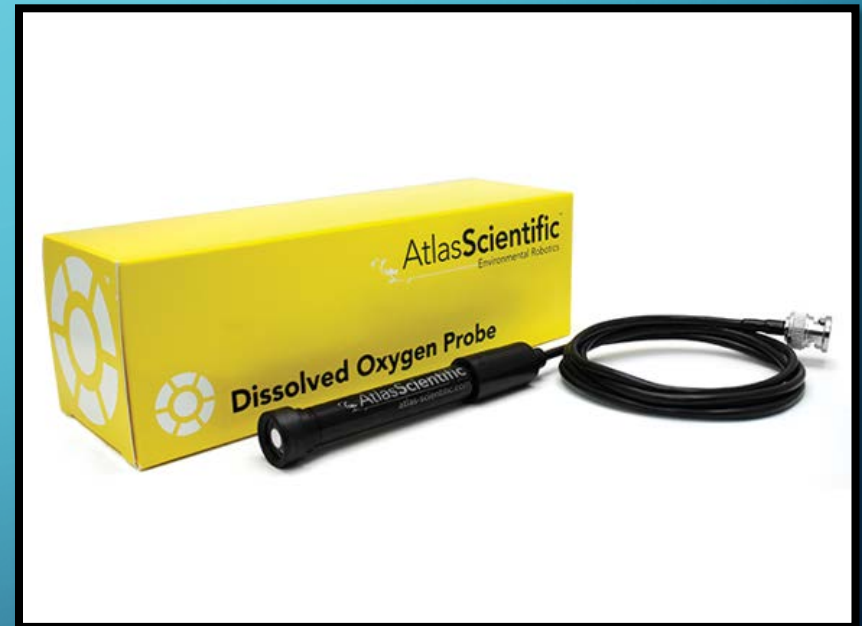- Type: Silver/Silver Chloride

CONDUCTIVITY PROBE (K1.0)

- Range: 5-200,000 µS/cm

- Max Depth: 343 meters

- Temp Range: 1-110°C

- Response Time: 90% in 1s

- Life Expectancy: ~10 years

- Type: Graphite

DISSOLVED OXYGEN PROBE

- Range: 0-100 mg/L

- Max Depth: 343 meters

- Temp Range: 1-50°C

- Response Time: ~0.3 mg/L/s

- Life Expectancy: ~5 years

- Maintenance: ~1.5 years

- Type: Galvanic Silver Cathode/Zinc Anode

EZO RTD (TEMP) CIRCUIT

- Range: -126.000 – 1254°C

- Accuracy: +/- 0.001

- Max Rate: 1 reading per sec

- Supports any brand of PT-100 or PT-1000 RTD

- Single point calibration

- Temp Units in °C, °F, or °K

- UART & I^{2}C supported

EZO pH CIRCUIT

- Range: 0.001-14.000

- Accuracy: +/- 0.002

- Max Rate: 1 reading per sec

- Supports any brand of pH probe

- 1,2,&3 point calibration

- Temperature Compensation

- UART & I^{2}C supported

EZO CONDUCTIVITY CIRCUIT

- Range: 0.07 – 500,000 μS/cm

- Accuracy: +/- 2%

- Max Rate: 1 reading per sec

- Supports any brand of K1.0 through K10 probe

- 1 or 2 point calibration

- Temperature compensation

- UART & I^{2}C supported

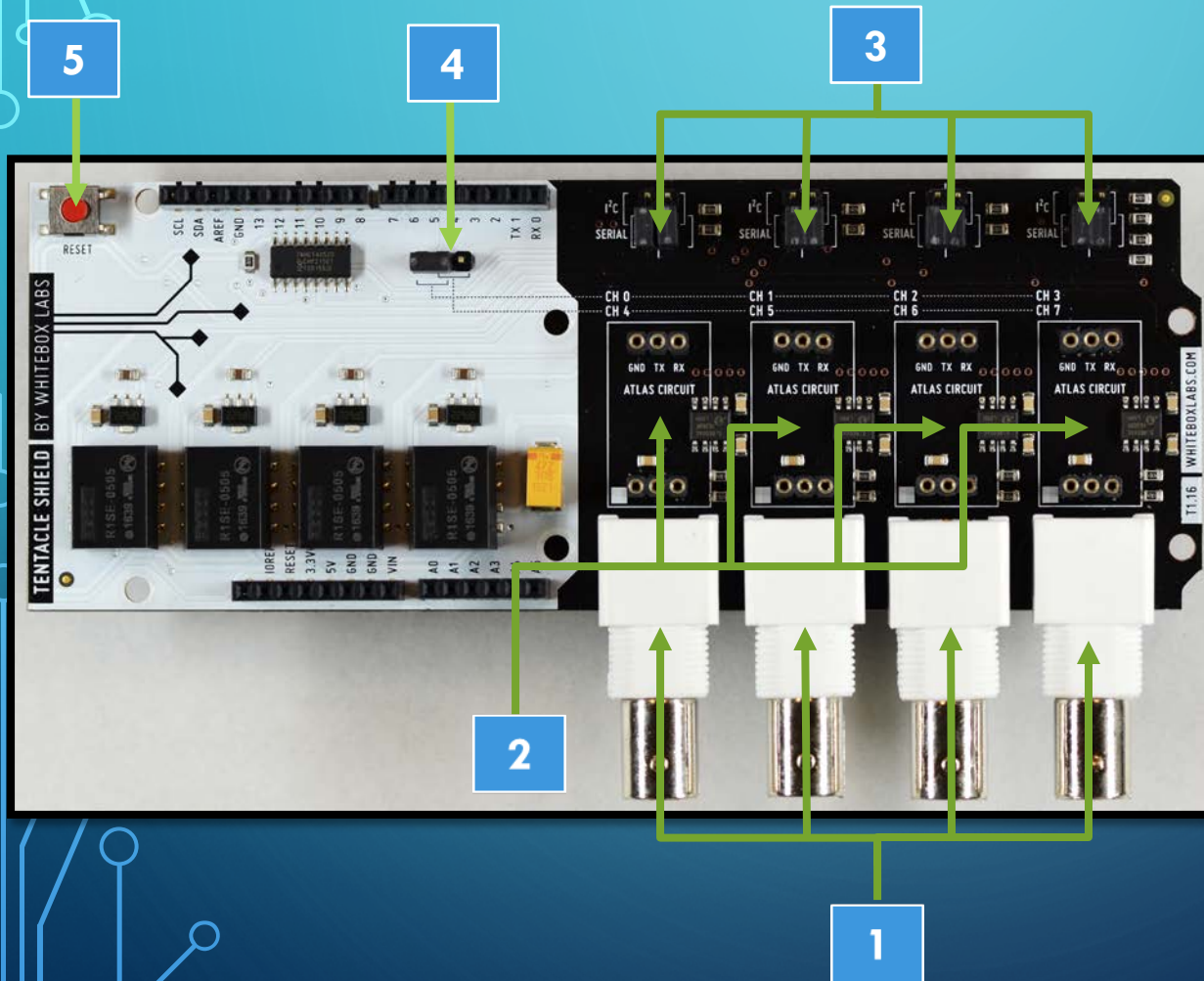- Will read conductivity, TDS, S.G. and Salinity

EZO DO CIRCUIT

- Range: 0.01 – 100 mg/L or 0.1 – 400% saturation

- Accuracy: +/- 0.05 mg/L

- Max Rate: 1 reading per sec

- Supports any brand of galvanic probe

- 1 or 2 point calibration

- Temperature, salinity, and pressure compensation
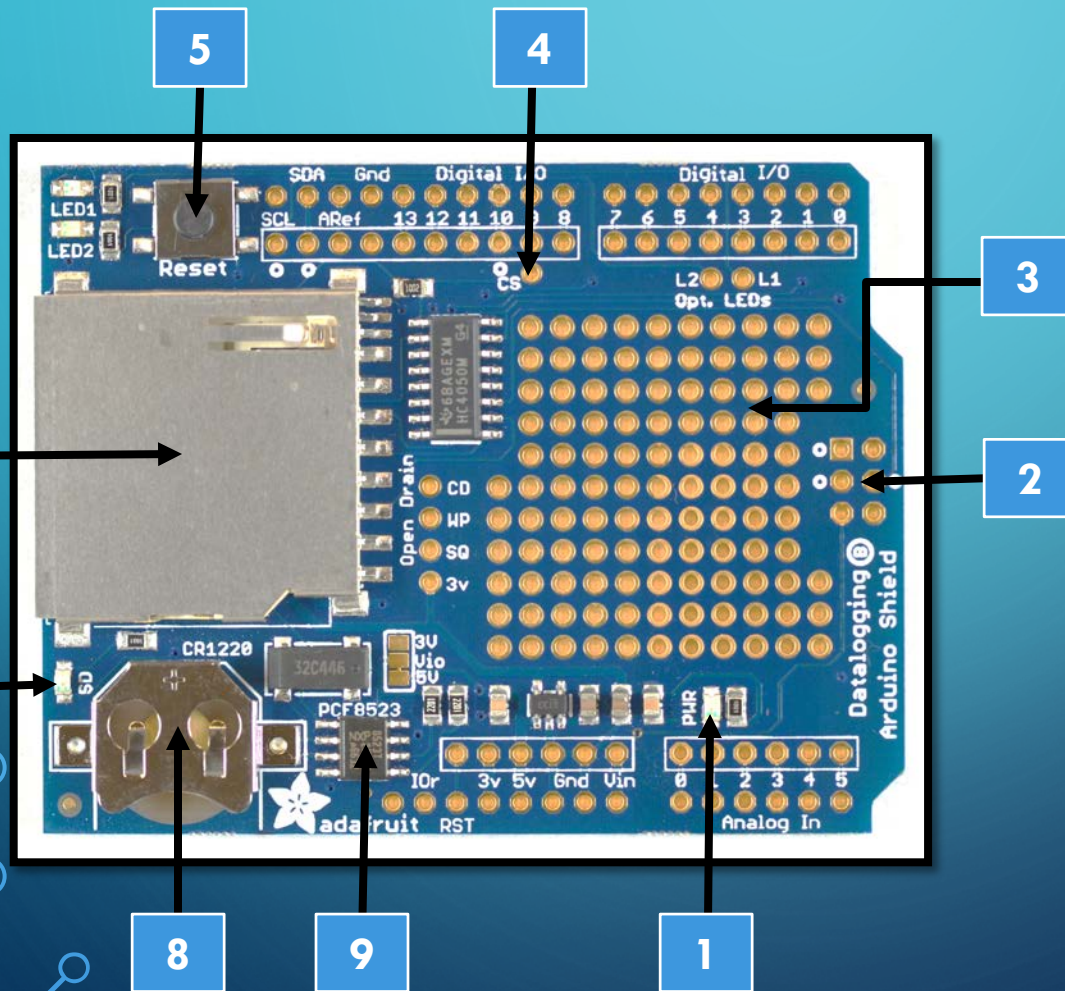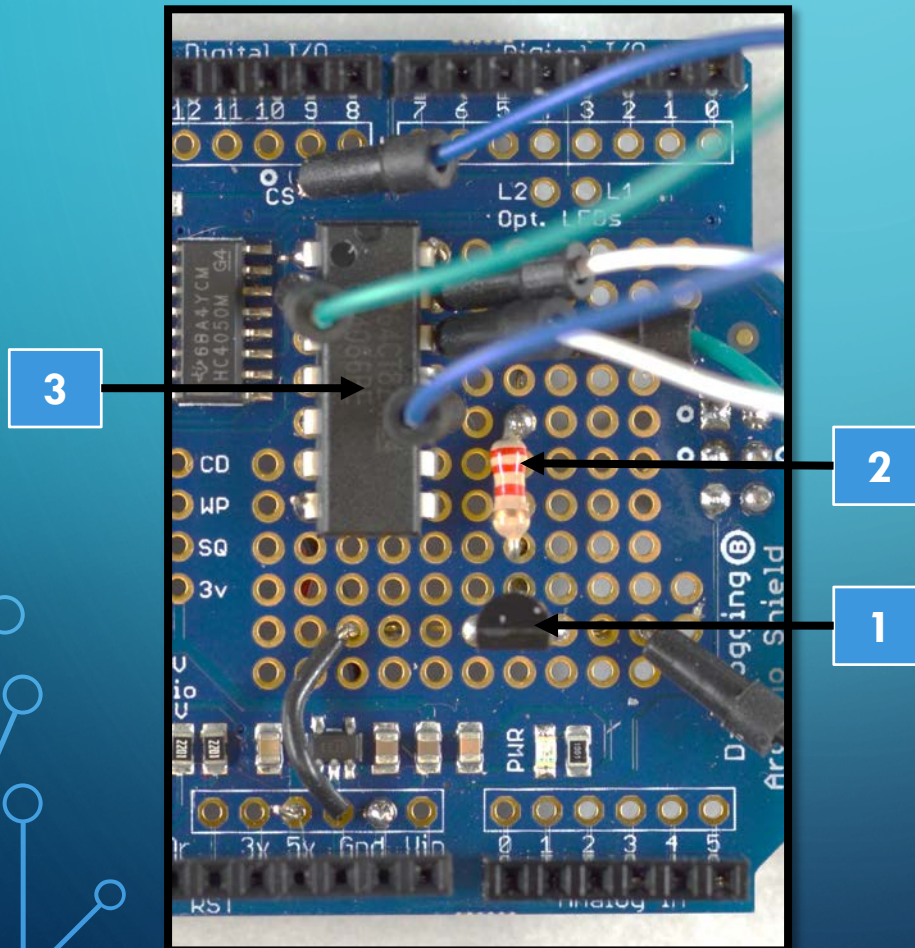
- UART & I^{2}C supported
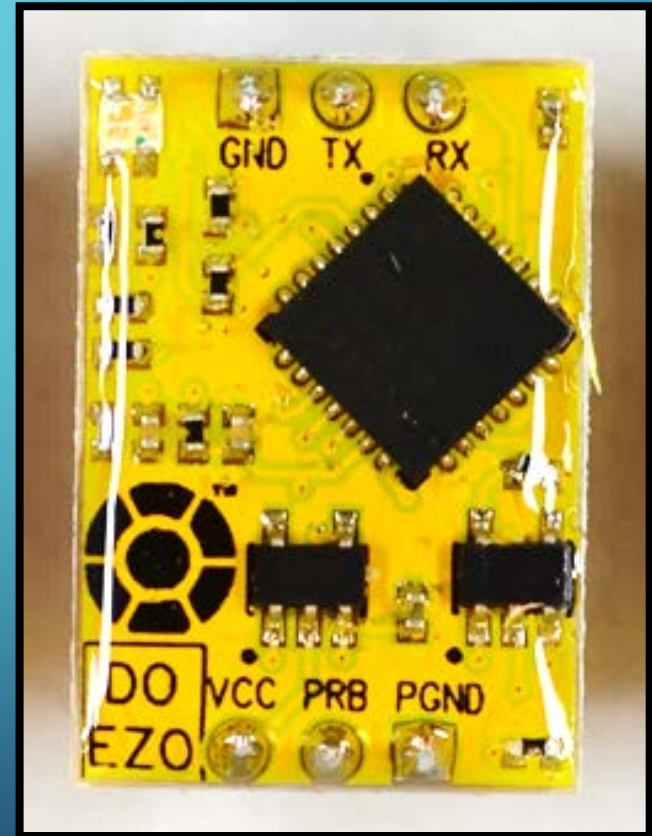
TENTACLE SHIELD

#	Component
1	BNC Connections
2	Probe Circuit Docks
3	UART/I²C Jumpers
4	UART Channel Jumper
5	Reset Button

DATA LOGGER SHIELD

#	Component
1	Power LED
2	SPI Coms
3	Protoboard Space
4	Chip Select
5	Reset Button
6	SD Card Port
7	SD Card LED
8	Lithium Battery Port
9	Real Time Clock

POWER MANAGEMENT CIRCUITRY

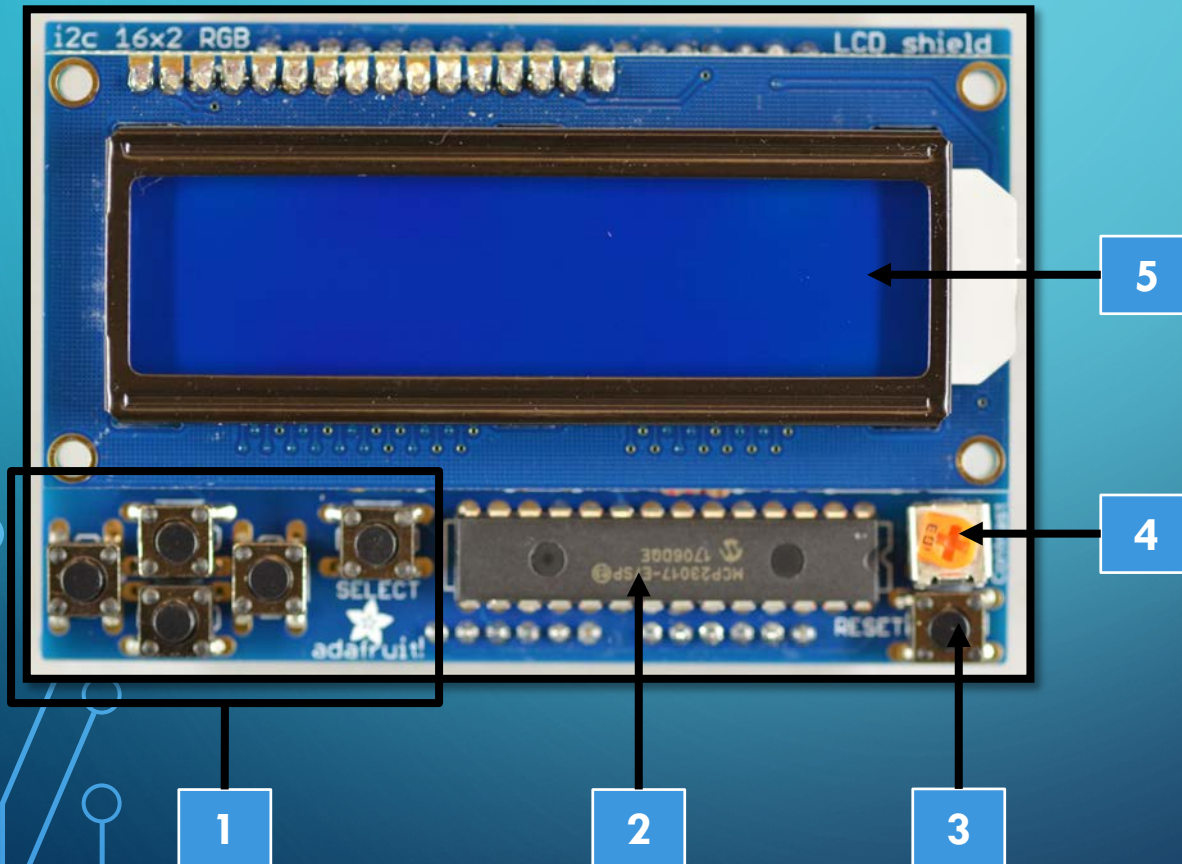| #	Component
1	NPN-Type Switching Transistor
2	2.2kΩ Resistor
3	CD4066B CMOS Quad Bilateral Switch

This components are used to disable/enable power and communications to the power hungry tentacle shield.

FONA808 SHIELD (CELLULAR MODEM)
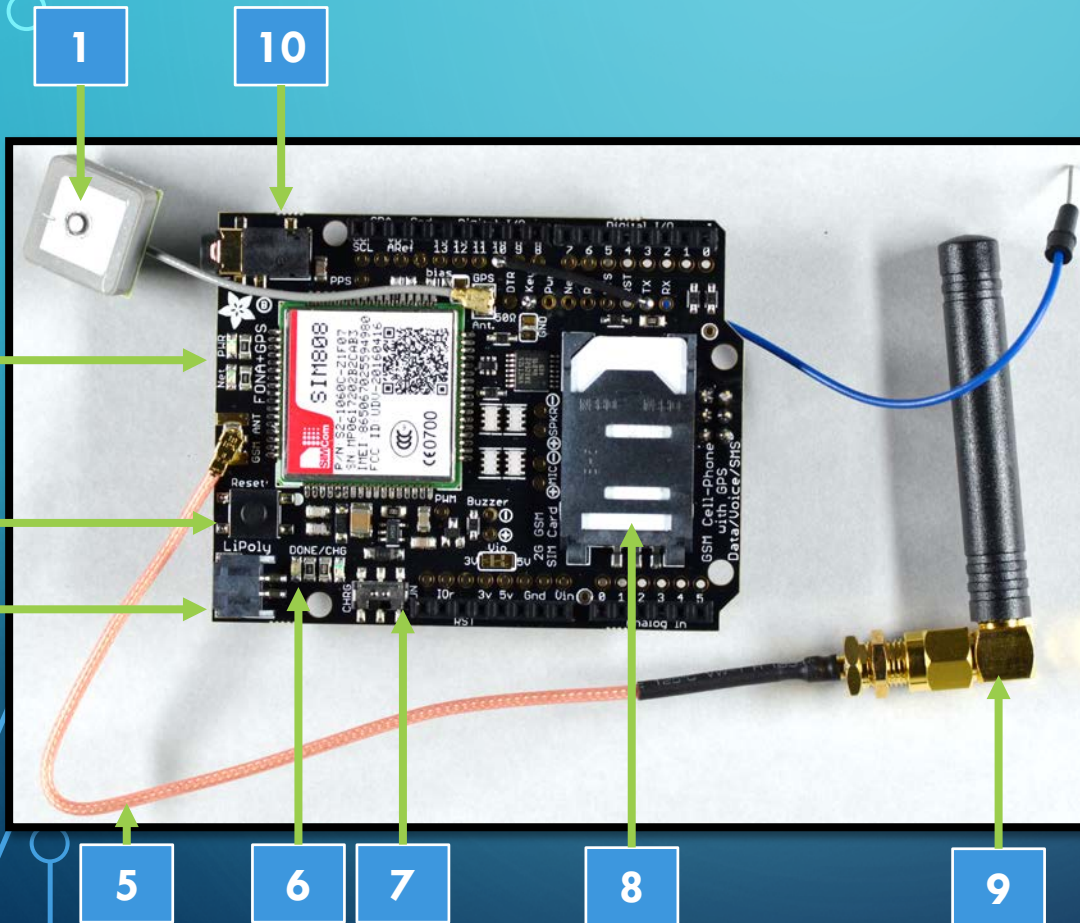
#	Component
1	GPS Antenna
2	Power/Network LEDs
3	Reset Button
4	LiPo Battery Port
5	Cell Antenna Adapter
6	Battery Charge LEDs
7	Charge/Run Switch
8	SIM Card Port
9	SMA Cell Antenna
10	SIM808 Processor
11	Microphone Jack

LCD SCREEN

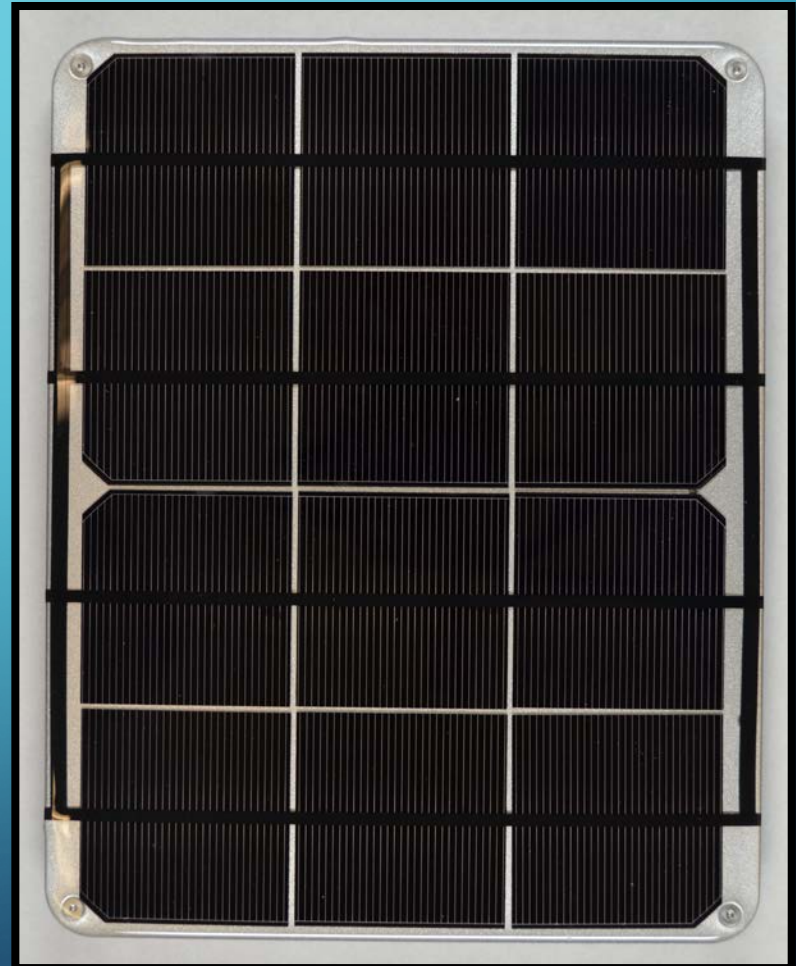| #	Component
1	Scroll/Select Buttons
2	I^2C Expander Chip
3	Reset Button
4	Potentiometer
5	16x2 LCD Screen

LITHIUM POLYMER BATTERIES

- 3.7V 6600mAh Lithium Polymer Battery as battery bank

- 3.7V 1200mAh Lithium Polymer Battery as cell back up
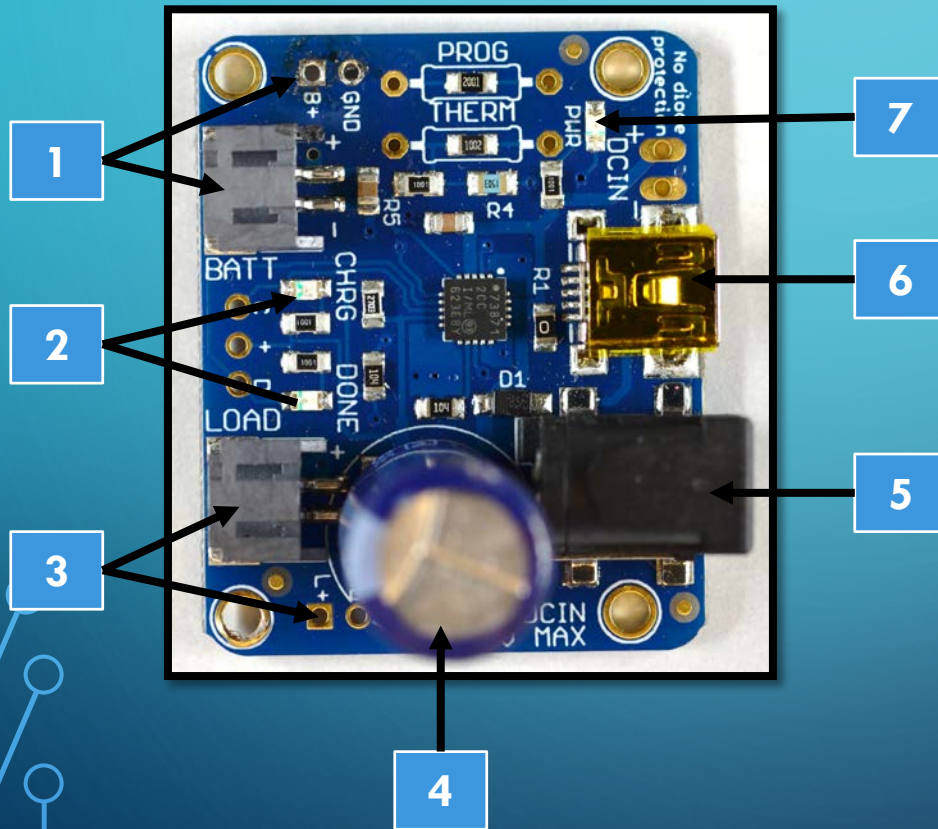

CHECK POLARITY WHEN PLUGGING IN!!!

SOLAR PANEL

- 6Volt 6Watt Panel

- Waterproof, Scratch and UV Resistant

- Outputs up to 930 mA at 6V

- 3.5mmx1.1mm DC Jack Power Cable

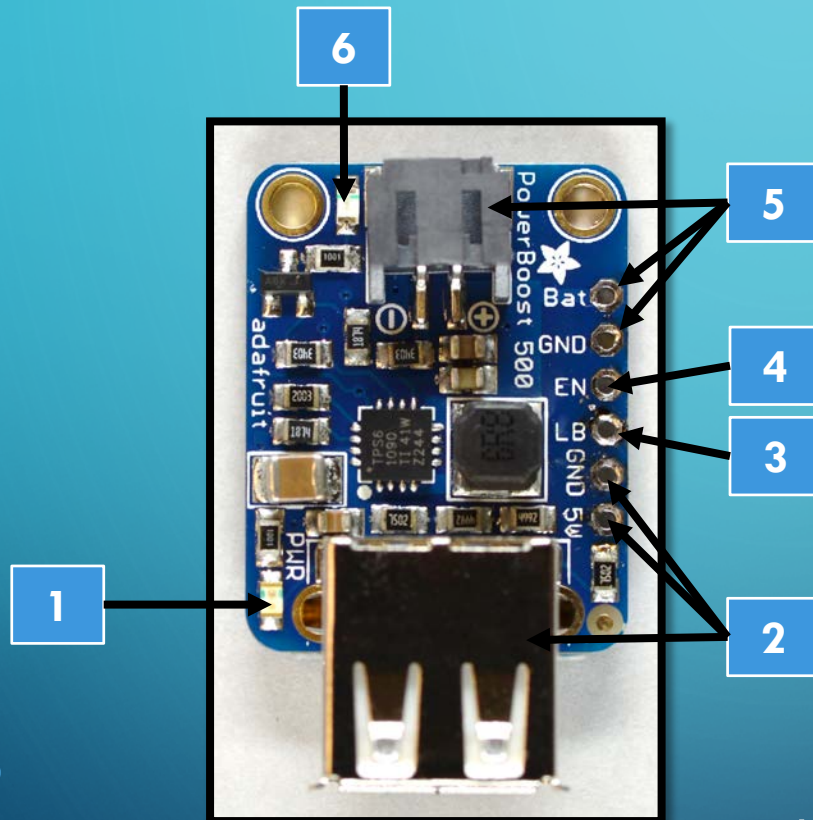- 5.5mmx2.1mm adaptor and 5ft extension cable

SOLAR CHARGER

#	Component
1	Battery Terminals
2	Charging LEDs
3	Power Output
4	Capacitor (4700μF, 10V)
5	DC Jack Input
6	Mini-USB DC Input
7	Power LED

5V BOOST CONVERTER

#	Component
1	Power LED
2	5V Output pin/USB
3	Low Battery Indicator Pin
4	Enable/Disable Output
5	3.7V Input pin/JST
6	Low Battery LED

This component is used to boost the 3.7V from the battery to 5V required by the Arduino circuitry.

EQUIPMENT COST

Hardware Components	Approx. Cost
Microcontroller	$40
Water Quality Probes & Circuitry (Temp, pH, D.O., Conductivity)	$760
Datalogger & Accessories (SD Card, RTC Battery)	$25
Cellular Telemetry with GPS & Accessories (Antennas & SIM)	$80
Lithium Polymer Battery Power & Solar Charging	$125
Weather Proof Enclosure & Accessories	$110
Additional Components (e.g. wires, tools, dessicant)	$70
Total=	**$1210**

Maintenance, Calibration & Data Plan Subscriptions	Approx. Cost
Probe Calibration & Maintenance Materials (Standards & D.O. Cap)	$115
T-Mobile 2G IoT/M2M Data Plan (100MB & 50 SMS per month)	$100
Total=	**$215**