

# Sediment Battery Preparation

## Materials Needed

- 1) Graphite electrodes (2 are required)
- 2) Insulated electrical wire
- 3) Electrically Conductive epoxy
- 4) Non-electrically conductive epoxy
- 5) Resistor (100 – 1000 Ohm)
- 6) Multimeter or voltmeter.
- 7) Wire cutters, wire strippers, plastic bucket, mud, water.

### **1) Graphite electrodes**

The graphite electrodes will serve as the anode and cathode of the sediment battery. One will be buried in the mud and the other suspended in the water above.

Electrodes are made to order from Graphite Engineering, Inc. (<http://www.graphite-eng.com>)  
They can prepare any shape and size required.  
We use their “Grade G-10” and have 8.9 cm diameter x 1.3 cm thick disks made.

### **2) Insulated wire**

A separate piece insulate wire is affixed to each of the 2 electrodes so that current may pass from the electrode through the wire.

We use Ancor Marine Grade wire (16 gauge) from (<http://www.ancorproducts.com/>)  
The gauge of wire is not important.  
Insulated wire may also be purchased at RadioShack ([www.radioshack.com](http://www.radioshack.com))

### **3) Electrically Conductive Epoxy**

Conductive epoxy is used to ensure a low-resistance connection between the graphite electrodes and the wire.

Electrically conductive epoxy is available from (<http://www.epotek.com>)  
We use their H20E silver epoxy. There may be other electrically conductive epoxies available as well.

### **4) Non-electrically Conductive Epoxy**

Non-conductive epoxy is applied after the electrically conductive epoxy has dried and is used to protect the conductive epoxy and any exposed wire from contacting water or sediment.

This epoxy is also available from (<http://www.epotek.com>).  
We use 730 UNF, but others may work as well.

### **5) Resistor**

A resistor acts as a simulated load to the battery and allows the measurement of current by Ohm’s Law  
 $V = I \times R$  where: V = voltage (volts) , I = current (amps), R = resistance-(Ohms).

Resistors are available in a variety of sizes at ([www.radioshack.com](http://www.radioshack.com)). We use resistance between 100 and 1000 Ohm.

## 6) Multimeter or Voltmeter

A multimeter or voltmeter is an electrical instrument which will measure voltage. At the very least, a voltmeter is required. The advantage of a multimeter is that it will measure current, resistance and voltage as well, the Fluke 73III Multimeter has all of the features needed. Whatever instrument is chosen, it must be able to measure mV accurately.

Multimeters are available at ([www.radioshack.com](http://www.radioshack.com)).

## Electrode Assembly

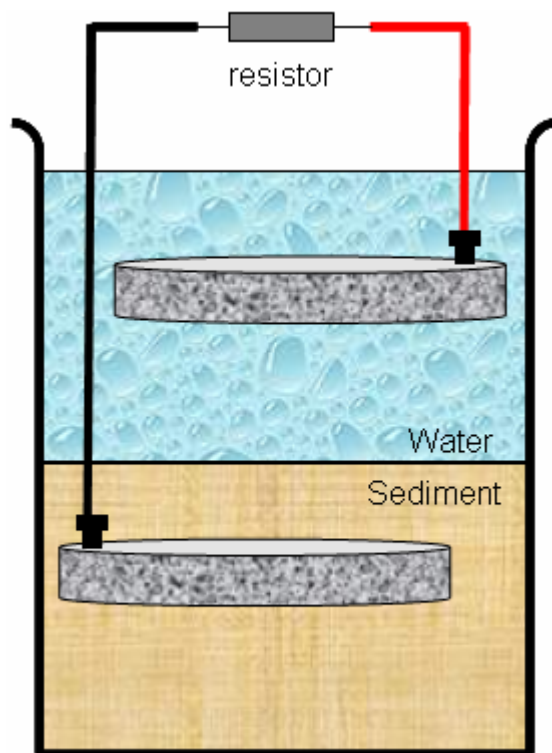
- 1) Cut insulated wire to desired length and strip about 4 mm of insulation from the wire using wire strippers or a razor blade.
- 2) Drill a small hole in each electrode. This hole may be in the top or side, depending on where the wire will be connected.  
This hole **SHOULD NOT** go through the graphite. It should be only deep enough to cover the exposed part of the newly exposed wire and a few millimeters of the insulation itself (~ 8 mm). The diameter of the hole should be large enough that the insulated wire may fit.
- 3) Drip enough electrically conductive epoxy in the bottom of the hole to cover the exposed wire. Insert the wire so that the exposed wire is in the epoxy and allow it to dry. After the epoxy has dried, test the electrode to make sure that a good connection exists between the graphite and the free end of the wire. This can be done with a multimeter.
- 4) After the conductive epoxy has dried, fill the remainder of the hole, generously with non-conductive epoxy. This will protect the electrical connection as well as give some mechanical stability to it. Allow epoxy to dry.
- 5) When you are finished, the electrode should look similar to the one shown below.
- 6) Repeat the above steps to make the second electrode.
- 7) Before assembling the sediment battery, test each electrode for good electrical connections between the graphite and the free end of the wire using a multimeter or other method.



## Sediment Battery Assembly

Notes: For best results, mud should be collected from the sediment at the bottom of a body of water, rather than made from a mixture of dry soil and water (although this will work also). The sediment battery should be made in a plastic bucket or glass beaker; metal should not be used.

- 1) Fill the bucket with a few centimeters of mud (~ 10 cm).
- 2) Place one of the graphite electrodes on the mud. This will be the “anode” of the sediment battery. Make sure to keep the free end of the wire dry and out of the mud.
- 3) Add a few more centimeters of mud (~ 5-7 cm) over the anode. The anode should be completely covered with at least a couple centimeters of mud.
- 4) Carefully pour water (preferably water from the same body of water that the mud was collected) over the mud and anode. Be sure not to uncover the anode or disturb the mud very much. Add water to at least 10 cm deep over the mud. Allow the particles to settle over night.
- 5) The next day, place or suspend the other electrode in the overlying water above the anode. This electrode is now called the cathode. As with the anode, keep the wires dry.
- 6) Connect the anode and cathode wires together with the resistor in between.
- 7) Your sediment battery should be configured as seen in the diagram below.
- 8) Using the multimeter or volt meter, measure the voltage. Place the red wire from the multimeter on the cathode side of the resistor and the black wire on the anode side. Record the voltage. Measure the voltage daily or more frequently.



### **Hints and Tips**

The current (Amps) may be determined by using Ohms Law as described above. Make sure to add fresh water occasionally so that the cathode does not become dry (it does not need to be completely submerged.) Try not to disturb the sediment by moving the sediment battery.