**Methods:**

The plan was to make 6 boxes using a laser cutter and with holes in them, which will make 3 sets. Then, using acrylic cement to attach a compression fitting(a PVC pipe tube with 2 end caps that screw on the end) in between 2 boxes. One box, the anode(positive) and another box the cathode(negative). Then make 8 electrodes(what are used to collect electrons) using nickel epoxy to attach bare wire on a carbon cloth. 2 for each set, one for the anode, and one for the cathode, with a spare set. Then 3 salt bridges were made inside of the PVC pipe parts of the compression fittings using agar and salt to distribute positive ions so the chambers charges stay balanced, so the cycle continues to make power.

Then, benthic mud (mud from just under under the leaves and sticks at the bottom of a stream), and stream water, were collected. Then the cathode chamber was filled halfway with mud and anode chamber with stream water and salt mix. Then, one electrode in the mud and another in the water. Then fill the rest of the cathode chamber with mud, and put the lids on, then the wires were connected by soldering one end of each to a 220Ω resistor. For the next 20 days, data on the voltage was collected. When the voltage started to go flat, the mashed up fruits and vegetables were mixed into one fuel cell, and sugar water with a similar amount of sugar as in the fruit, and vegetables into another fuel cell, and more mud into the last one. Then data was collected for the remainder of the time and then data will continue to be collected after the presentation until the voltage cuts off.

**Paper section:**

Using a program to design box parts to be cut by laser cutters, a 3.5in by 3.5in by ~6.2in acrylic box layout, with ridges to fit together like a jigsaw puzzle was designed, and cut by a laser, and then a 1ml hole in one of the sides was cut by a laser cutter. In the science buddies plans the box was 3.5in by 3.5in by 6 5/16in, but on the website it specifically said that the size of the containers is unimportant, and the software used couldn’t do fractions so the dimensions were rounded, because it was not worth the effort to get the exact measurements.

6 boxes, 2 per set, were needed and 1 of the 3 sets was made early, to make sure the schematics we made worked properly. The set was made by laying out the pieces of the box next to each other, and using an acrylic cement. Using the acrylic cement a bead was ran along the inner part of each ridge in a way that the acrylic cement formed a straight line.Then the pieces of the box were folded up, and then the box was held still for approximately 30 seconds. Then they sat for 22 hours.The next night, the other 2 sets were done the same way.

The night after a silicon calk was run along the inner edges of the box so they would not leak. The next morning, the smooth part of the compression fittings and their caps were scratched up with sandpaper so that the the surface of the cap was scratched up so that the acrylic cement would stick better. Then, an approximately 1 inch area around the hole was scratched up with sandpaper until the scratched area was almost white, but scratching was still visible. Then the compression fitting was labeled by, putting an “A” on each cap of the compression fitting for one, and the same thing with “B”, and “C” for the other 2 boxes.

Then one of the boxes was put on its side, and a bead of acrylic cement was added in a circular motion approximately in the center of the scratched area. After that, the same was done on another box. Then, one end of the compression fitting was attached to one of the boxes, and held there as the box was moved into the upright position. After that the other box was pressed up against the other end of the compression fitting, and after that the boxes were clamped into place gently, as to prevent the boxes from breaking. The same thing was done for the 4 remaining boxes to make 3 total sets. Then the boxes were set aside.

After that, a (insert wire type here) was cut into 6 18inch(45.72cm) pieces using a wire cutter, and because it was (type of wire) there were 12 18in pieces of wire. Then using the wire cutter, 6in(15.24cm) of one end of the wire was striped off, and ~2/5in(exactly 1cm) of the other end was striped off. Then using scissors, the carbon cloth was cut into 8 5X5cm(7.87402in) sections by cutting a 5X20 strip, and then using a ruler cutting the 5X20 strip into 4 5X5 sections.

Then a table was covered in newspaper and the wire was bent with pliers to fit the shape of the carbon cloth. After that, the two part nickel epoxy was squeezed into 2 piles and then mixed together with a toothpick. Three of the 8 wires were, one at a time, dipped in the pile of epoxy and then pressed into the carbon cloth. When the wires started to fall off the process was switched to using the toothpick to paint on the epoxy to the wires and then pressed to the carbon cloth and propped up on a box with the wire side facing down so the carbon cloth was held against the wire with gravity.

The following night the tube sections of the compression fittings was unscrewed and set aside. Then, plastic wrap was used to cover the bottom of a petri dish, and the petri dish was set aside. After that, tinfoil was used to cover the bottom of the tube section of the compression fitting, and the checked to make sure it was secure. The same was done to the other two tubes and the tree tubes were then placed on the petri dish. Then using a 250 ml liquid measuring cup water filled to the 250 ml line and poured into a pot, and then water was filled to the 50 ml line and poured into the pot. Then using a scale, that measured to the 100th of a gram, and a small glass dish, 30 grams of agar were measured out, as well as 6 grams of iodized salt into a separate glass dish.

Then the 300 ml of water were brought to a boil, after 5 minutes, on the stove. Then the agar was poured in all at once, and was stirred with a glass stir rod. The liquid in the pot turned a light brown, with small chunks less than 5 mm long and less than 2 wide. The pot was taken of the stove, and the 6 grams of salt were added and stirred with the glass stir rod. Then with the stir rod the now viscous liquid was guided into each tube, filling them to the brim, with the glass stir rod. Then the tubes were put in the fridge for the night. The next morning they were placed in a plastic baggy.

The next afternoon, a multimeter was set to resistance mode( a mode where if signal was sent from one of the multimeters electrode to its other another a beep would go off), and one electrode was placed on the carbon cloth, and the other electrode was placed on the bare end of the wire. The multimeter beeped indicating a connection, and the same thing was done to all 7 of the other electrodes, with each one indicating there was a connection.

Then samples were collected from a wetland approximately a 10 minute walk into the woods. Then using a medium sized, metal, handheld shovel, and a four gallon bucket, approximately 1 ⅓ gallons of mud were collected. Then using a one gallon milk jug 1 gallon of stream water was collected. After the mud was taken home, approximately 2 cups of tap water was added to the mud.

Then about 3 hours after the mud was collected, the salt bridges were taken out of the plastic bag, and were connected to the two corresponding anode and cathode chambers. Then using a 2 cup measuring cup. 12 cups of the stream water, were measured out into a jug, 2 cups at a time. The instructions that were being used called for 6 Table spoons, but because there wasn’t enough table salt, 4 tablespoons of table salt were used and 1 tablespoon of kosher salt were measured out into a glass dish. Then the salt was added to the jug and then stirred with a metal spoon. Then the cathode chamber was filled, but water leaked out of the salt bridge, so after the water was removed using a bulb baster, plumber's tape was applied to the threads of the compression fitting and the water was re added, with no leaking this time. Then plumber's tape was applied to the other 2 chambers, and after, that they were filled with the salt water.

Then the wire end of an electrode with white wire was threaded through the smaller hole of one of the lids with 2 holes. Then one of the tubes for the air pump was threaded through. Then one of the air stones was attached to the end of the tube. Then the same was done two more times. Then with a metal ladle the mud was scooped up and a plastic ladle to catch any mud if it were to fall. Then the first container was filled half way. After that an electrode with black wire was placed in the mud. Then the container was filled to the brim with the mud. After that the wire end of the electrode was threaded through a lid with one hole, and the lid was put on top of the container, and 2 rubber bands were put on the lid to keep it from opening if bumped. Then using a soldering iron a 220Ω resistor was solderd to the bare section of the electrod wires.