pHloat

Materials & Fabrication Plans

Materials: Costs & Purchase Locations

Total costs for purchased materials & Tools: $27.82

Many materials do not need to be purchased and can be gathered from recyclables or exchanged for other similar objects thus significantly lowering the price.

Pre-owned/Pre-existing Arduino Microcontroller

Moisture & pH Sensor, Home depot $7.58

Plastic container (Make sure to have matching lid), from home or purchased Wal Mart $.99

9v Battery, American Science & Surplus $1.95

9v Battery attachment with leads, American Science & Surplus $.50

Electrical Tape, Home Depot $.59

22 gage (suggested) stranded hookup wire, Radio Shack $2.50

White (preferred) Duct Tape, from home or Home Depot $2.99

20mA 4-Pin 130° view angle LED (red, green, blue), Superbrightled.com $.59 each (1.77)

Small piece of insulation foam to make 8” circle, Found or purchased Home Depot, $2.00

1k & 1 10k ohm Resistors, Radio Shack $.99

PCB board (recycled) or Radio Shack $1.99

Rope (recycled) or Home Depot $.21 per foot, length up to your discretion

Transistor, Radio Shack, $.99

Two ½" Diameter Dowel Rods, Home Depot $2.00

Pre-owned/Borrowed Drill

Various drill bits for wood and plastic

Soldering Iron & Solder

Fabrication

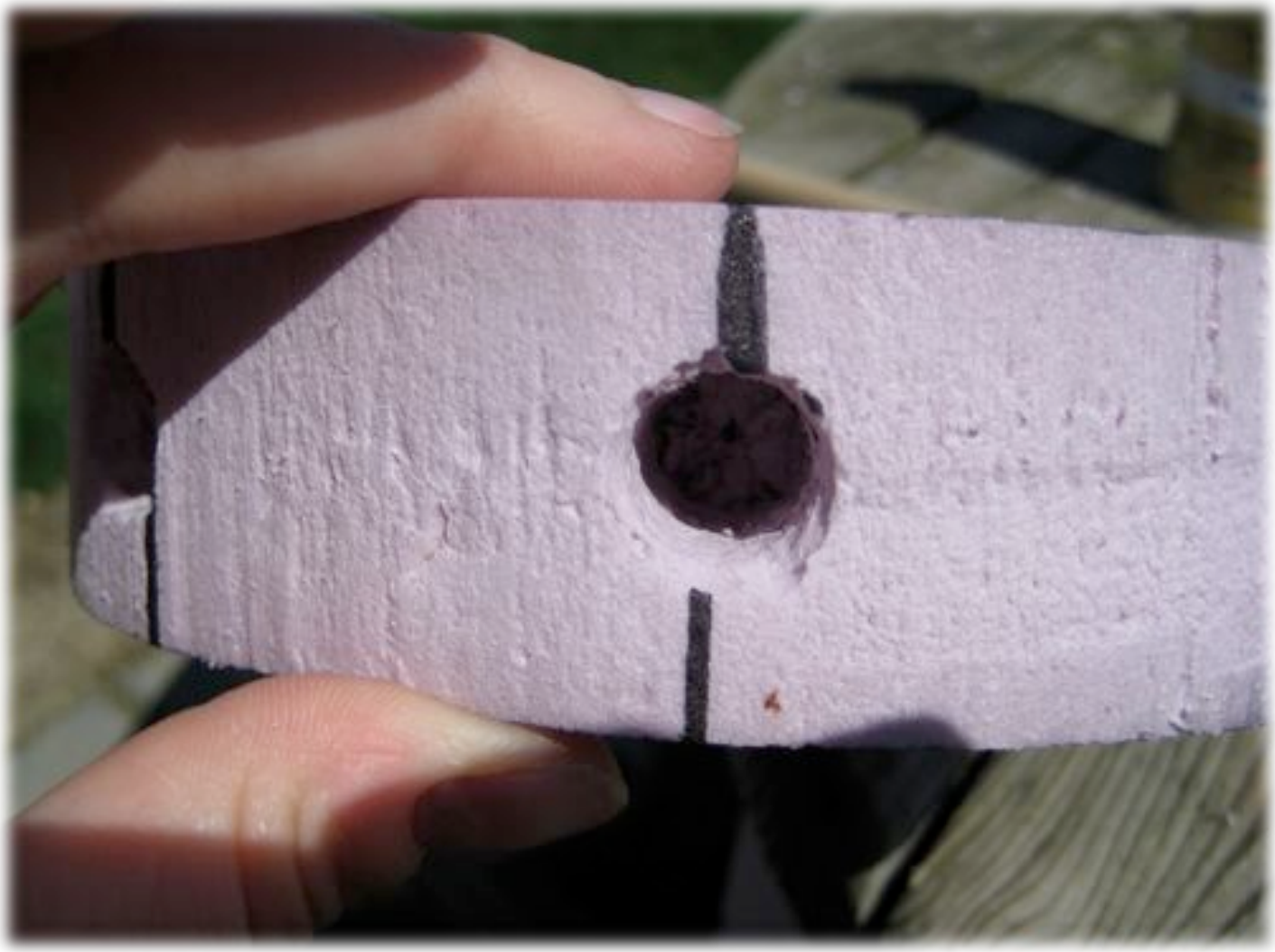
1. To begin, gather your piece of Styrofoam, a permanent maker, string, and a

pushpin.

2. Cut a small piece of string approximately 9 inches long. Tie one end of the string to the top of the pushpin and the other end of the string to the marker. Push the pin into the Styrofoam. Pull the string taught with the pen and draw a circle. Follow the images below:

3. Cut out the circle using a razor blade or small hacksaw. You will want the edges to be nice and clean so bits of the Styrofoam do not flake off. Next divide the circle into eight equal sections. After you have divided the circle into eight equal parts, at the end of each line, measure along the side and make a dot at 1.5" down. Repeat this eight times.

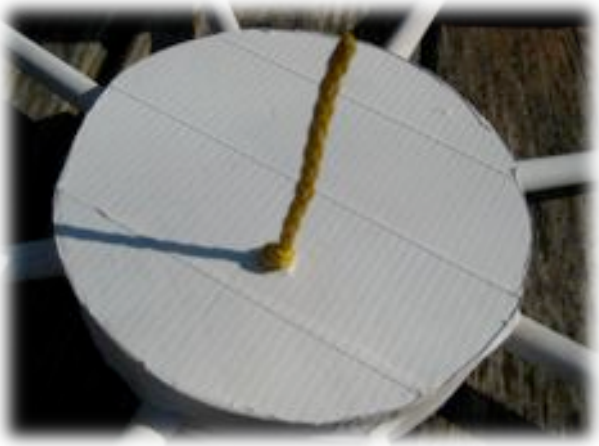
4. Drill ½" holes at each mark along the edge of the circle. Drill each hole approximately 1" deep. You should have 8 holes when you are finished that are equally spaced apart.

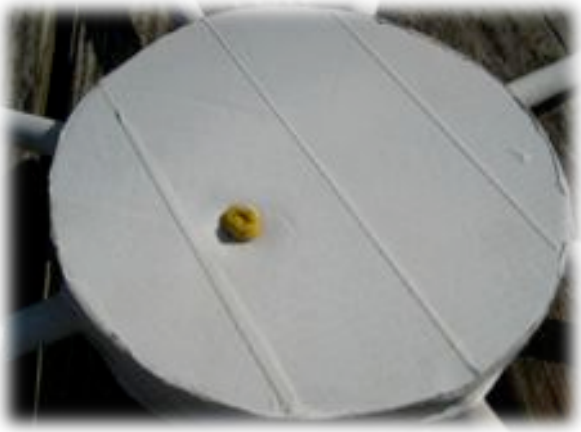


5. Next, use the duct tape (preferably white for aesthetic reasons) to cover the exterior of the foam. This helps to waterproof the base and to prevent any pieces of loose foam to become loose and pollute the water. Be careful and do NOT cover the holes that you made in the previous step

6. After you cover the circle form with duct tape, affix a 6" dowel rod into each hole. They stay in best if you put a small bit of glue in the hole. Hot glue works best. I spray painted my dowels so that the pHloat was all one color and could be seen easily in the dark. Spray painting is not necessary.

Next drill a small hole into the pHloat. Do not do this in the center. After the hole has been drilled, pull a small piece of rope (approximately 6' in length) through the hole and tie a knot. This will allow for the pHloat to be retrieved easily.



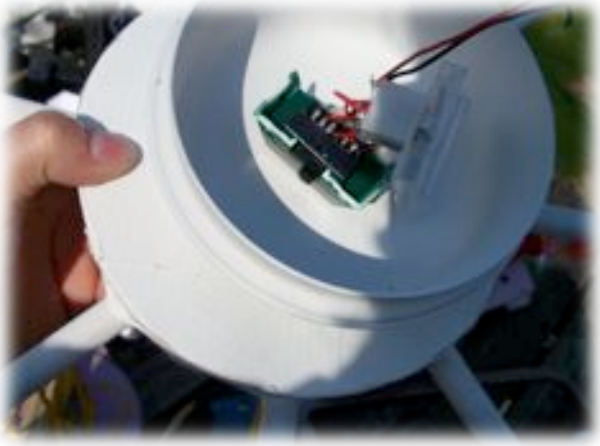


7. Next take your plastic container and drill two holes in the bottom of the container spread about 1" apart. The holes should be about the same diameter as the legs of the pH sensor found in the kit.

8. Place the bowl on top of the pHloat in the center. Make a mark on the pHloat where the two holes in the container are. Drill the two holes using the same size drill bit. Finally, glue the bowl on top of the pHloat form. Follow the images below.

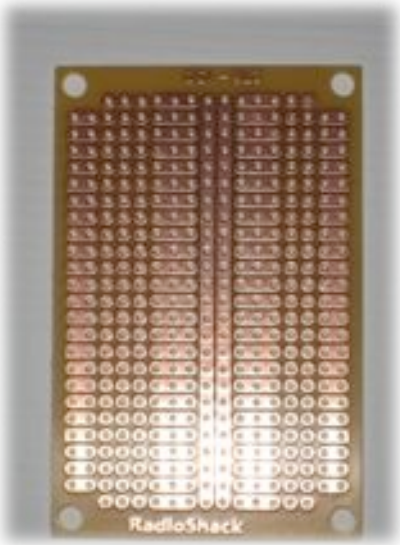


9. Place the pH sensor leads through the two holes that you just made.

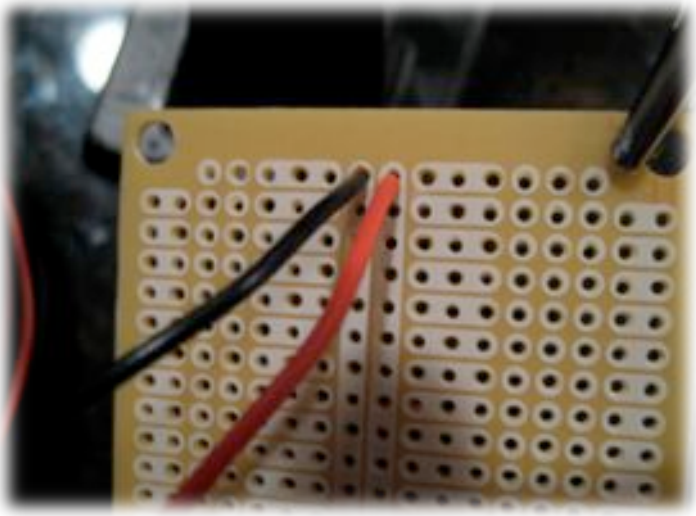


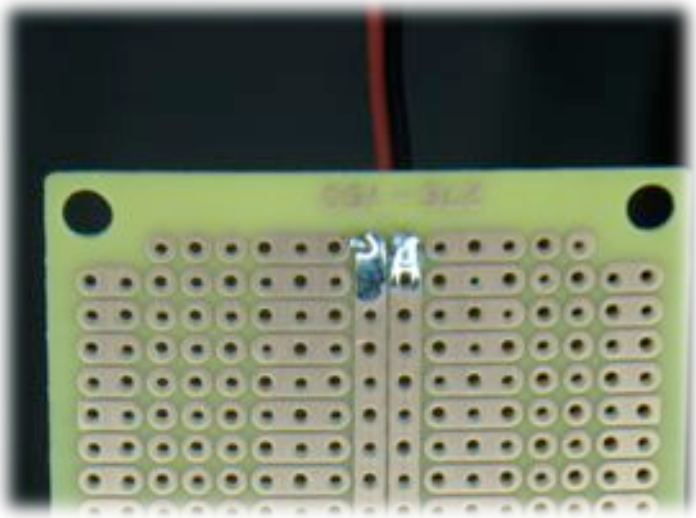

10. Take the lid of the container and drill holes for the wiring in the top. You will need between 4-6 holes depending on the thickness of the wire.

11. We will now work on building the circuit. Find your PCB board. Any small size/shape will work fine.

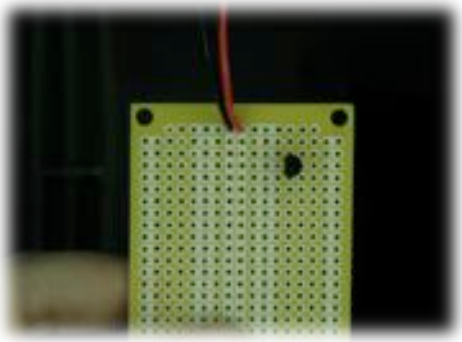
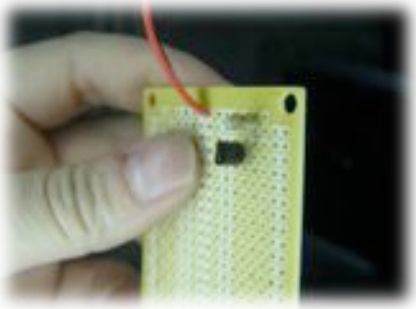
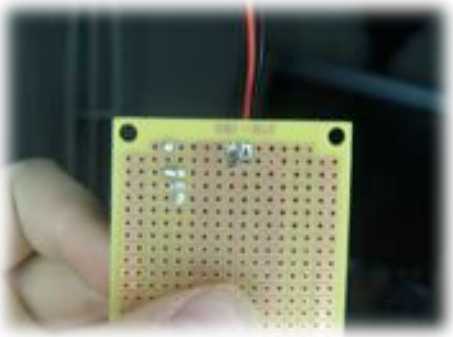


12. First solder a black wire (for ground) and a red wire (for power) as shown. Use the 22 gauge stranded wire for all wiring done on the breadboard.

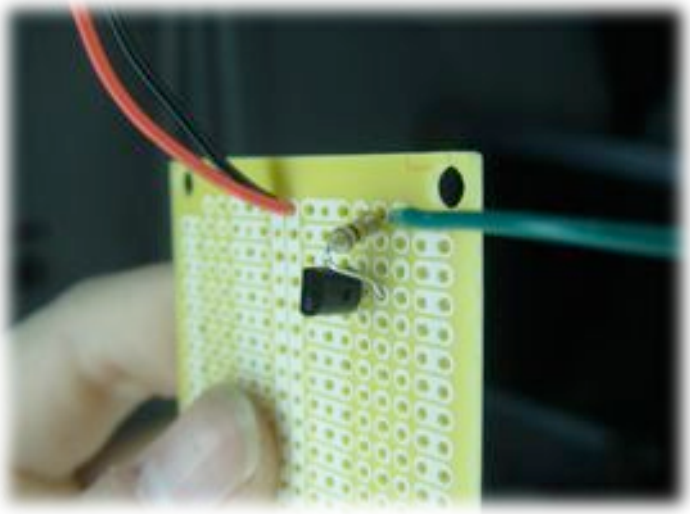
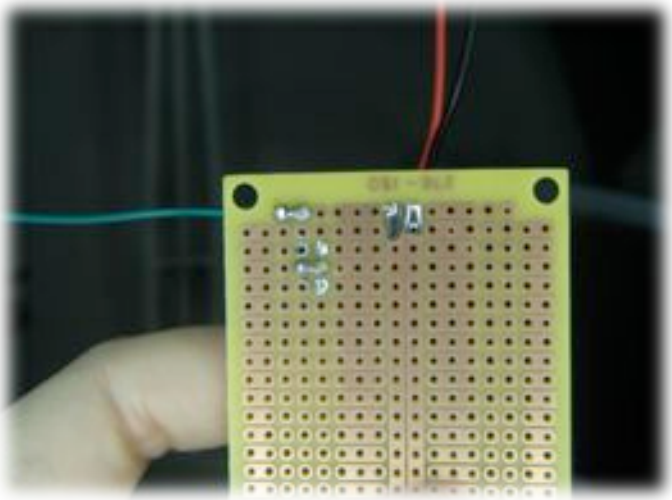




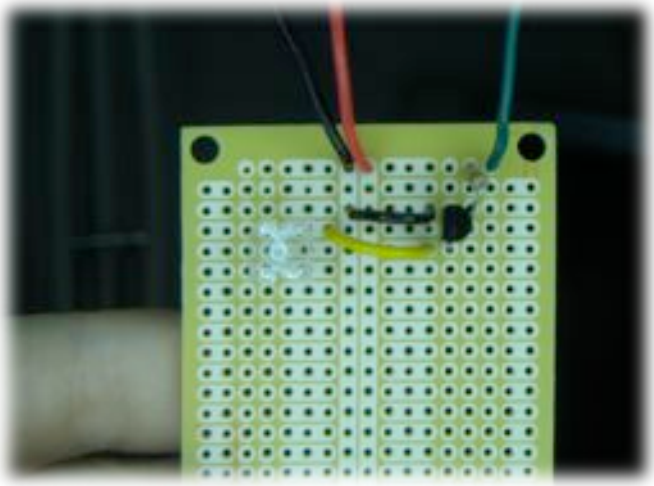
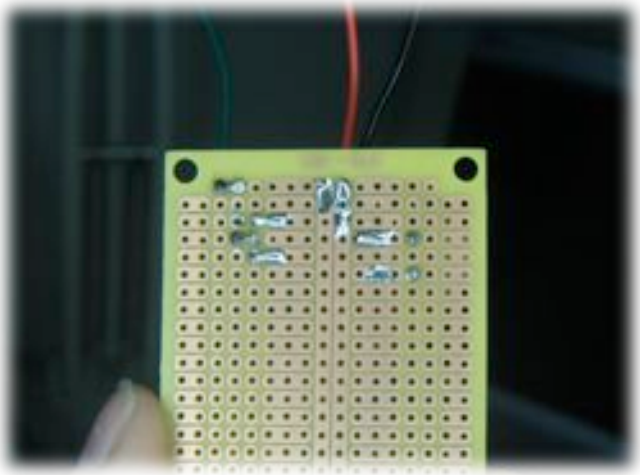
13. Next attach the transistor and 10k resistor as shown.

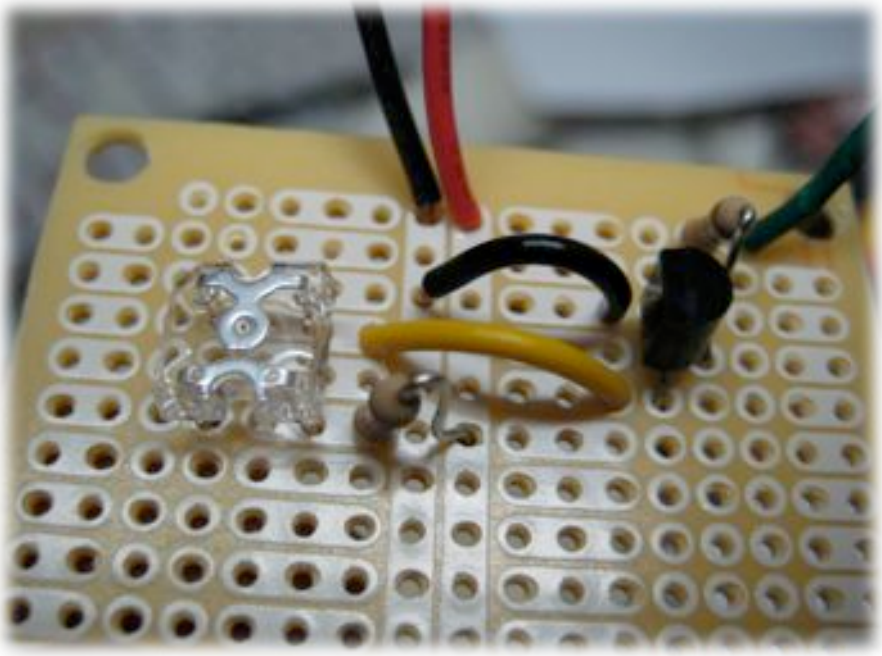
14. Attach a wire in the same line with the 10k resistor. See the photo below.

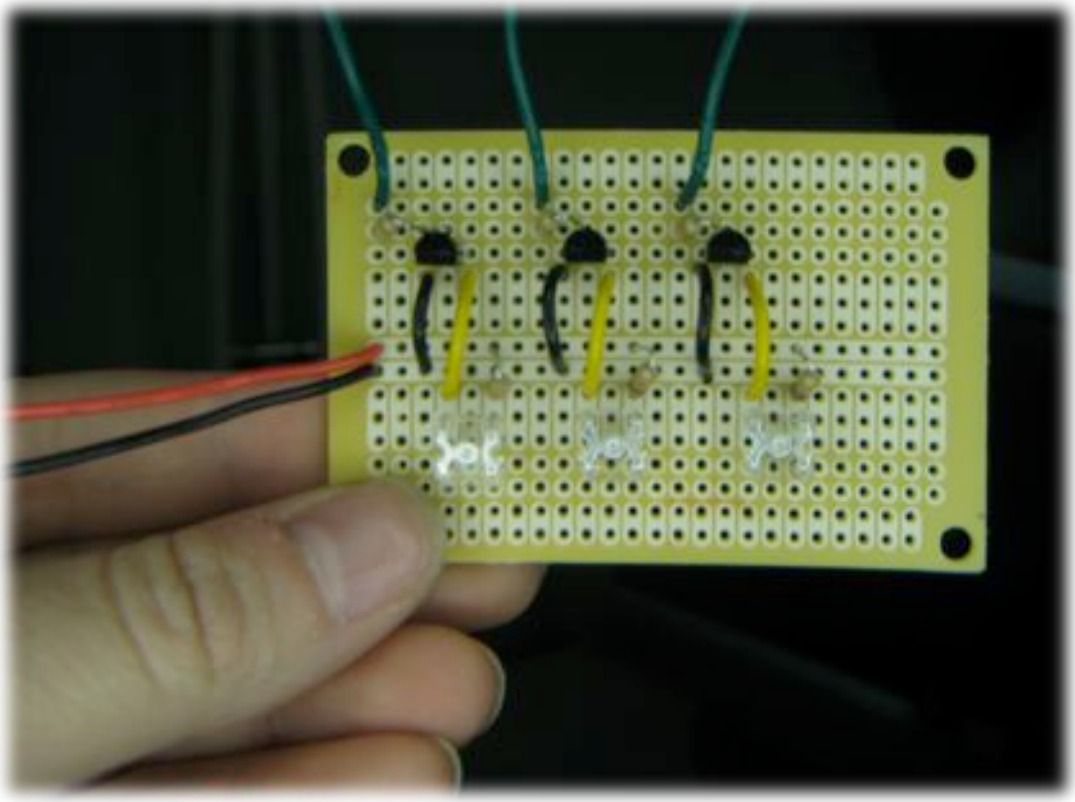
15. Attach another wire from the emitter of the transistor to the left leg (positive) of the green LED. See image below.

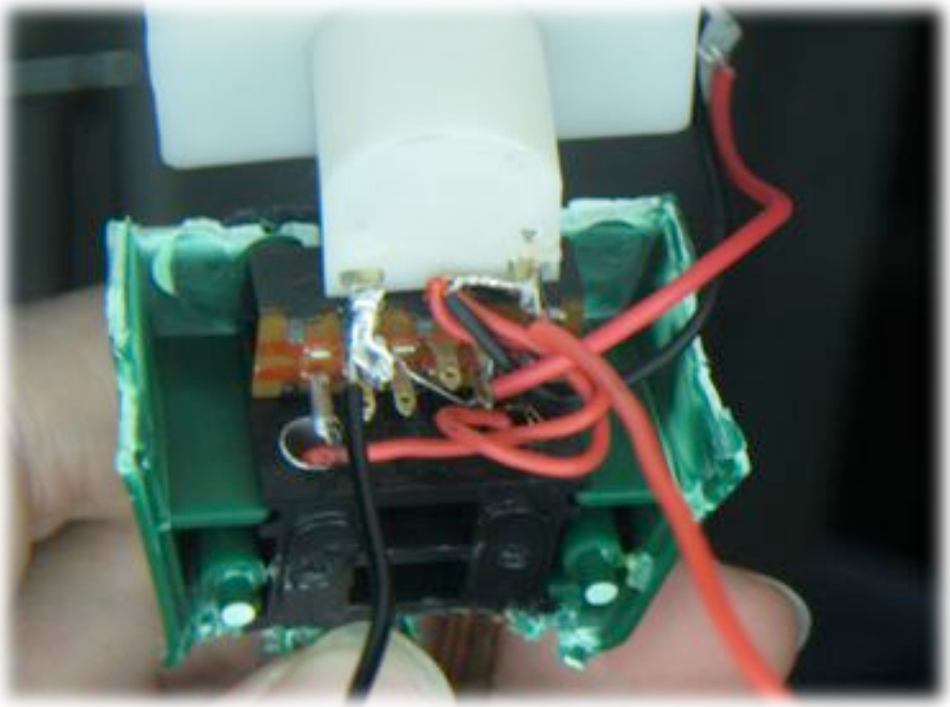
16. Attach a 1k resistor from the Positive (right) leg of the LED to the power 'rail' as seen below.



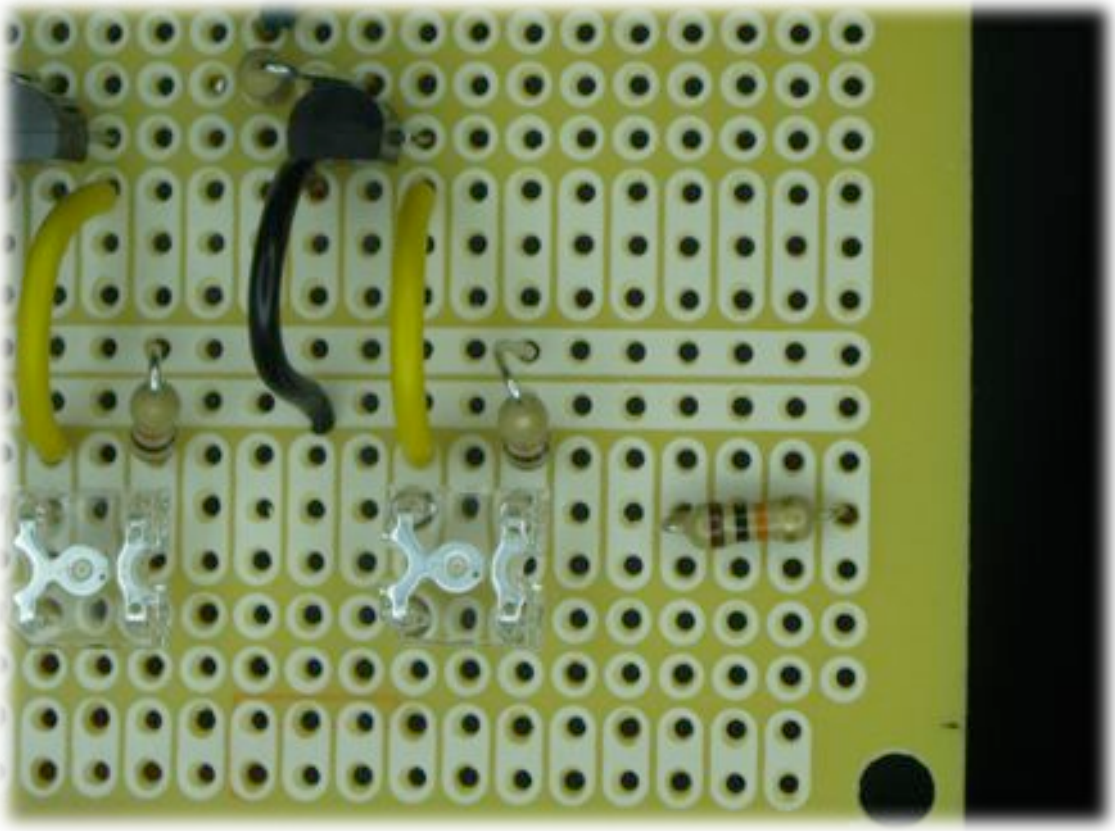
17. Repeat steps 12 through 16 two more times to put the blue and red Led's in place. The board should look like this when you are done.



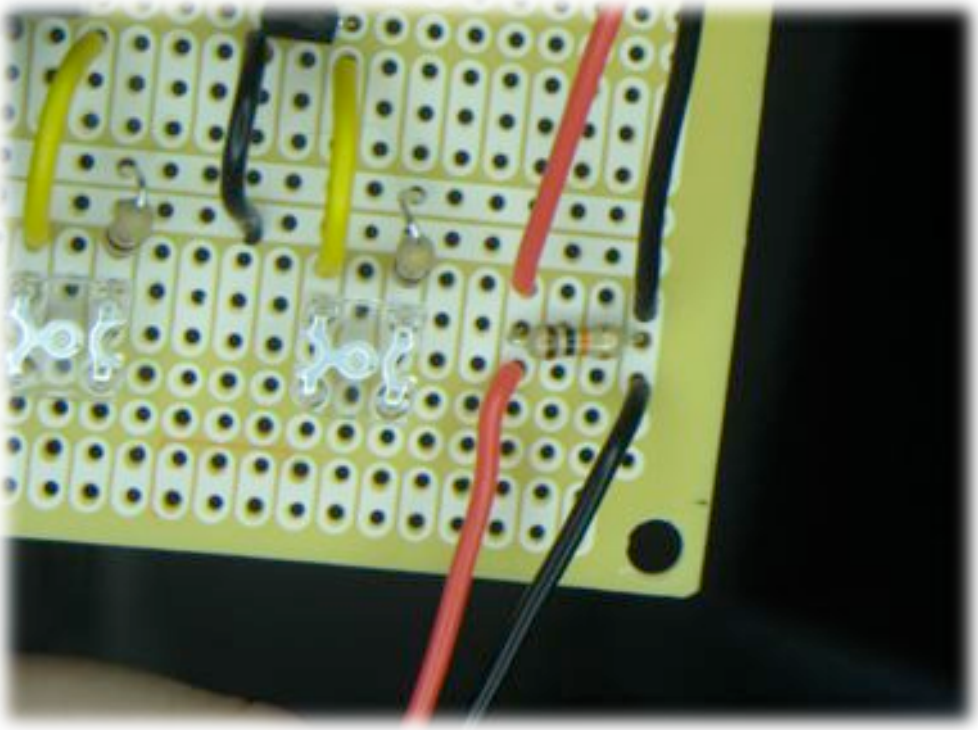
18. We will now work on making the pH sensor, which will be the mechanism that tells us the pH level of the water. Open the pH sensor; the best way to do this is using a pair of side cut pliers. Be careful, there are wires inside that you will need to keep in tact for the sensor to work properly. It should look like this when you open it up. Attach a black wire to the lead as shown below and the red wire (coming from the bottom right), to the other lead as pictured.

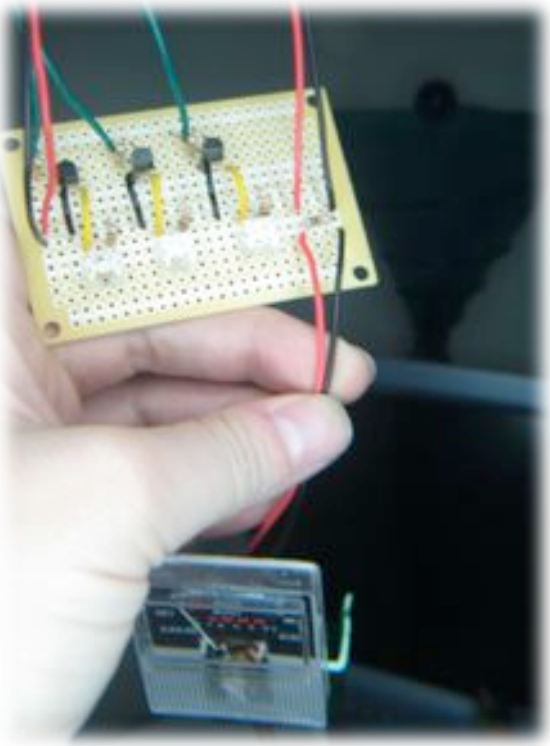


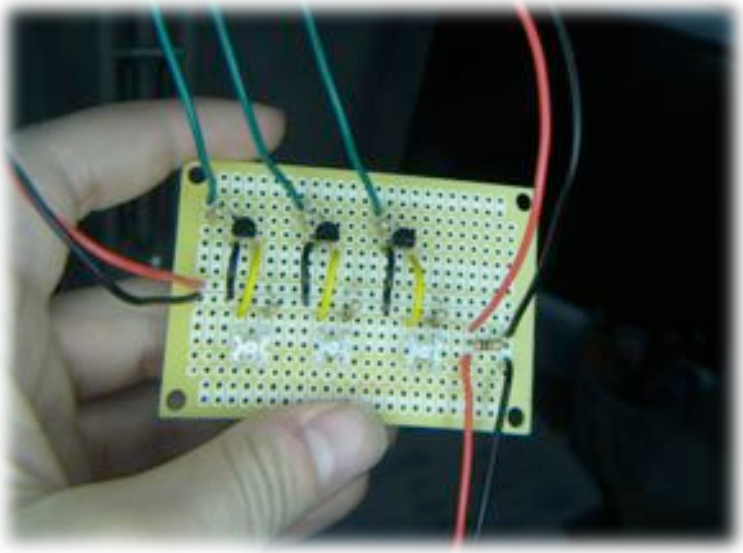
19. Go back to your breadboard. Attach a fourth 10k resistor outside of the other previously made circuits. Attach it so it is flush to the board.



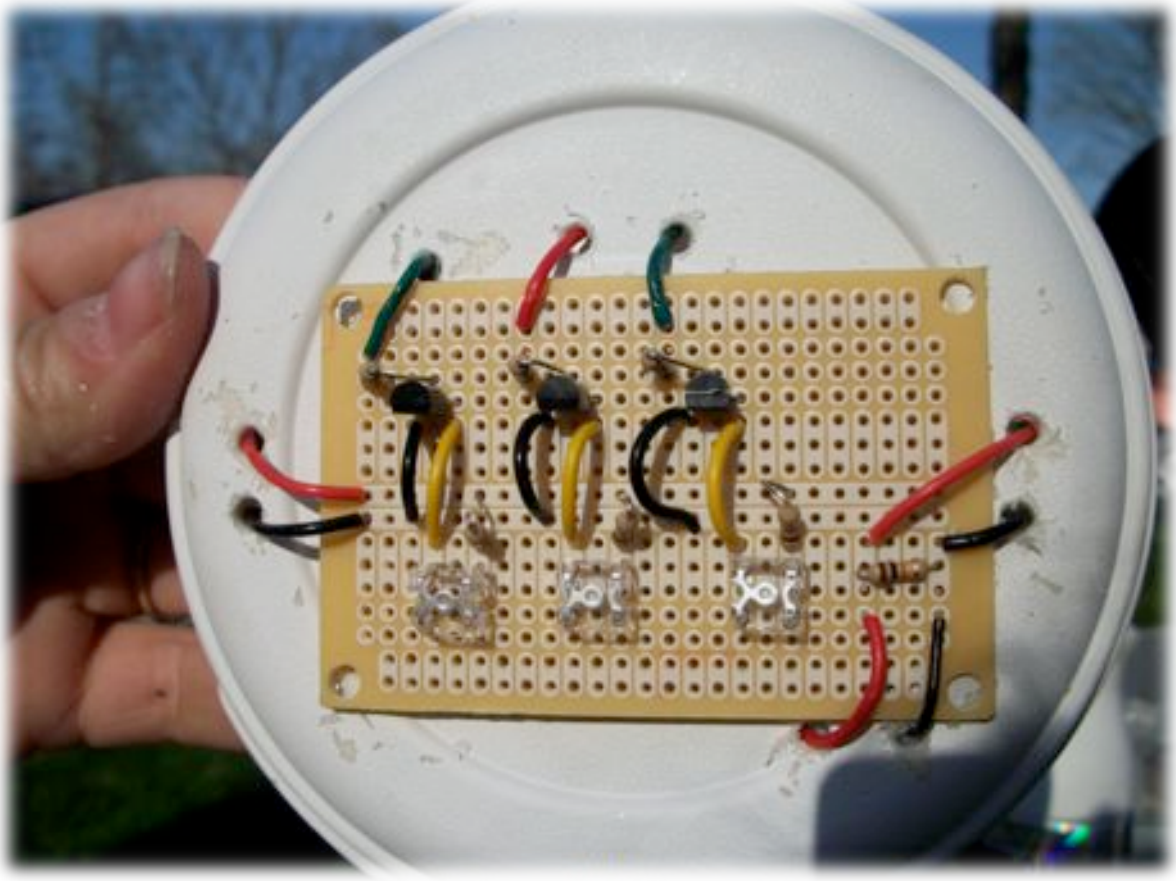
20. Attach the black wire and the red wire coming from the pH sensor (that you attached in step to the pH sensor in step 18) to the bottom of the resistor. On the other side of the resistor, solder in two red and black lead wires. See below and follow:







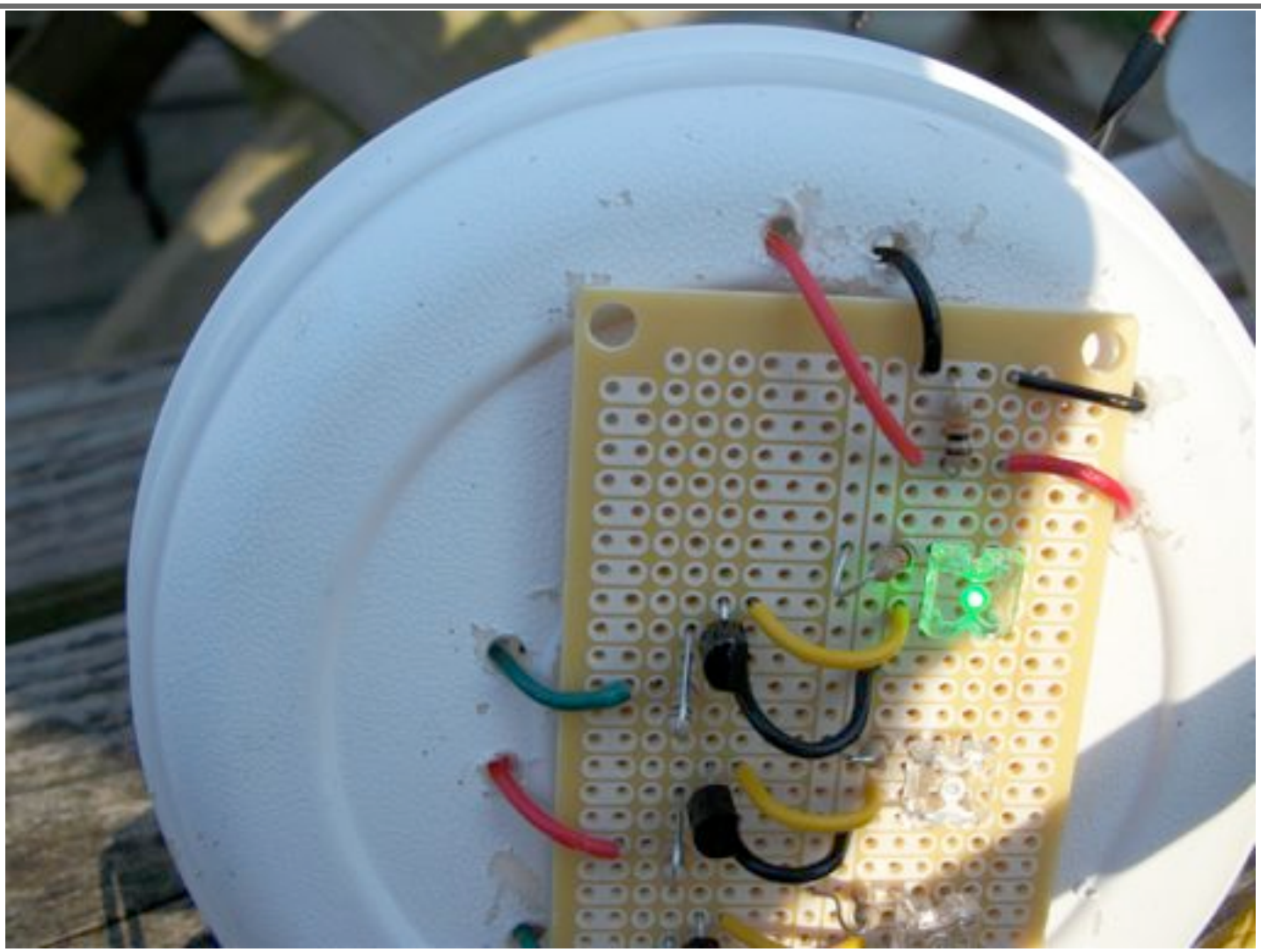
21. Place the circuit board on the top of the lid and run the wires through it.



22. Download the following code to your arduino microcontroller. After you download the code the light on the board should turn green. When the pHloat detects moderately high acidity levels in water the light will turn blue. When the pHloat turns red it has detected dangerously acidic. This code should achieve these results.

```
int LED = 13;//output pin is #13 for normal acidity level

int LED1 = 12;//output pin is #12 for middle acidity level

int LED2 = 8;//output pin is #8 for high acidity level

int sensorValue = 0;//"place" to store the incoming analog values to be read

int sensor = 1;//sensor input attached pin #1


void setup() {

pinMode(LED,OUTPUT);

pinMode(LED1, OUTPUT);

pinMode(LED2, OUTPUT);

pinMode(sensor, INPUT);//you don't have to declare "INPUT" since arduino seta all pins as input. I do it for remembering...

Serial.begin(9600);//get ready for serial communication

}

void loop() {
```

```
sensorValue =analogRead(sensor);//read the sensor and put the value in the sensorValue "place"

Serial.println(sensorValue);//pint out on the serial monitor...

if(sensorValue >= 15)//should turn on the red LED because the pH sensor reading is greater than or equal to 15 meaning that the acidity level is dangerously high.

digitalWrite(LED2, HIGH);//turn on the red LED

else

digitalWrite(8,LOW);//should turn on the red LED because the pH sensor reading is greater than or equal to 15 meaning that the acidity level is dangerously high.

if(sensorValue >= 4 && sensorValue <=14)//should turn on the blue LED because the pH sensor reading is greater than or equal to 4 and less than or equal to 14 meaning that the acidity level is dangerously high.

digitalWrite(LED1, HIGH);//turn on the blue LED

else

digitalWrite(12,LOW);//should turn on the blue LED because the pH sensor reading is greater than or equal to 4 or less than or equal to 14 meaning that the acidity level is higher than normal.



if(sensorValue <= 3)//should turn on the green LED because the pH sensor reading is less than or equal to 3 meaning that the acidity level is normal.

digitalWrite(LED, HIGH);//turn on the green LED

else

digitalWrite(13,LOW);//the green LED will continuously stay on because it includes the value of 0 (less than or equal to 3

}
```



23. Plug in the 9v battery to the arduino and move the power guard from USB to PWR. Assemble all of the electronics so that they all fit inside of the container (with the exception of the pcb board). It should look like this:

24. Next you will want to make the paper shade that protects the pcb board. Inside of the kit there are 7 piece of vellum already torn to the correct size. The instructions for how to make the shade is available in video form at the following link: http://www.youtube.com/watch?v=3hysDXOWRCM. Attach the shade using glue. Hot glue works best and dries the fastest.

25. Glue the shade to the lid of the container. Plug in the battery and tuck the arduino, battery, and wiring into the container. Tightly place the lid on the container. Your pHloat is now complete and ready to float!