Home Built Hydroponics Unit for an 8th Grade Science Classroom - The Hydroshack Lives Again!

by **Mikey D** on July 28, 2008

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intro: Home Built Hydroponics Unit for an 8th Grade Science Classroom - The Hydroshack Lives Again!

My wife teaches 8th grade science. This project "The Hydroshack" is a rendition of one I built over 20 years ago in my college teaching methods class. It is designed specifically for performing experiments in a science class. It therefore incorporates some modifications for flexibility and control purposes. It also needs to be collapsible for storage in tight quarters. If you are considering building something similar for your home, it can be less complex.

Please keep in mind that this instructable is not the only way to do this. You can build a frame from wood or PVC pipes or anything else of which your imagination can think! Your only limitations are the space your Hydroshack may occupy and the skills you bring to the project. If you are unfamiliar with welding, please use another construction technique.

Features:
Uses NFT (Nutrient Film Technique) - Nutrient solution flows along the bottom of the troughs and washes over the plants roots.
Very dense plant arrangement to accommodate 150 students in a 5' x 2' footprint
Counter top unit that breaks down to be stored above the cupboards in the classroom
Easy access to replenish and clean the nutrient tanks.
Flexible controls to allow for differing conditions: nutrient flow, nutrient solutions, lighting etc... in each trough.

Educational conditions:
The Hydroshack will be used to teach the students the "Scientific Method" (formal experimental procedures) and also be used in the genetics portion of the class. It is designed for hands on learning and assuming all goes well, will stay in production well past the completion of these units and throughout the semester.

Parameters of this Instructable:
This Instructable will feature the construction of this unit. It is not a primer for hydroponic growing. While my wife and I have done considerable research in order to design The Hydroshack to be as efficient as possible, we are not authorities on the subject. I will be making references to the process of hydroponic growing throughout this instructable, but only as a reference as to why some of the elements have been designed this way.

The numbers in each step correspond to the position of the pictures in each step. I will be presenting the construction in the most logical order, not the order in which the parts were fabricated. If you see daytime in the first picture, then it gets dark, and then returns to daylight, just run with it! :-)

Also, I had to redesign the control panel. The double gang box that was originally used did not allow us to use both timers and instead of trying to cobble together adapters and extension cords, I figured on doing it right. The sharp eyed folks out there will catch glimpses of the original control panel as the revision was made after painting.

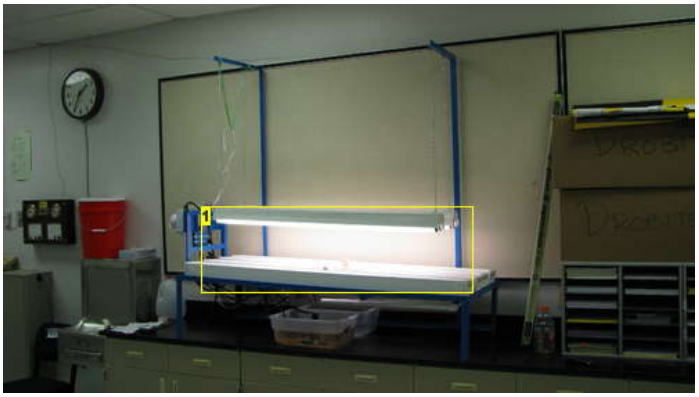


Image Notes
1. In service

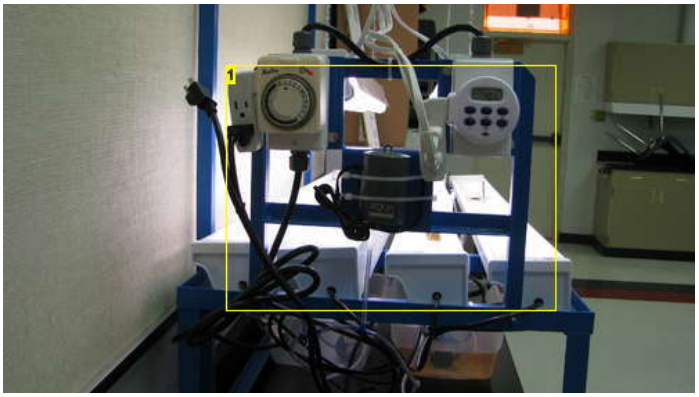


Image Notes
1. Organized Chaos!

step 1: Tools

Please keep in mind that this is only the way I constructed this version of the Hydroshack. Using different construction methods and varying the design will require other tools and skills. Please be safe when using any hand or power tools. Lastly, This is quite probably only a partial list of tools. I tried to make it as complete as possible but it is entirely conceivable I grabbed a pair of channel locks from the toolbox for a quick twist and forgot to take a picture. :-)

In no particular order...

1. Safety first - Welding safety gear.

2. Assortment of welding clamping and positioning devices.

3. Measurement and marking devices.

4. My trusty, dusty 110V MIG welder.

5. Dry cut saw - cuts mild steel (ONLY!) one piece at a time (ONLY ONE) like it's butter!

I Love this saw, it cuts very quickly, with minimal heat, no smoke and NO BURR! It beats the wheels off of an abrasive cut-off saw. It also has the fastest fence change and adjust I have ever seen. Going from 90 degrees to 45 degrees takes about three seconds!

6. Compound Miter saw (could use a hacksaw also)

7. 4-1/2 inch angle grinder with a few different wheels. Pictured is a flap wheel, I also used grinding wheels and a wire wheel.

8. Pneumatic cut off grinder. (for those ooopses)

9. A corded Electric drill and twist drill bits.

10. An electricians step drill with some twist drills.

11. An extension for a drill that holds the hex type screwdriver tips, and a #2 philips and #2 square drive screw driver tips

12. A hammer, center punch and marking device.

13. Linesman pliers for heavy duty snipping.

14. A utility knife and an assortment of screwdrivers.

15. Bolt cutters and the ubiquitous screw driver.

16. A rattle can handle!

17. A small propane torch and a tapered punch

18. A Microwave oven and Pyrex measuring cup (any microwaveable dish will work)

19. A magnetic sweep. (so we can walk barefoot out here when I'm finished)

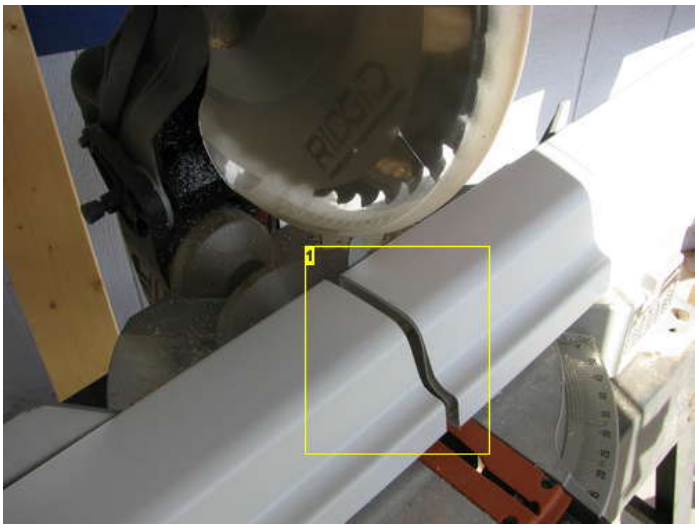


Image Notes
1. rain gutters already cut


DB 160C
60 PIECE
DRILL BIT SET
Snap-on
Milwaukee

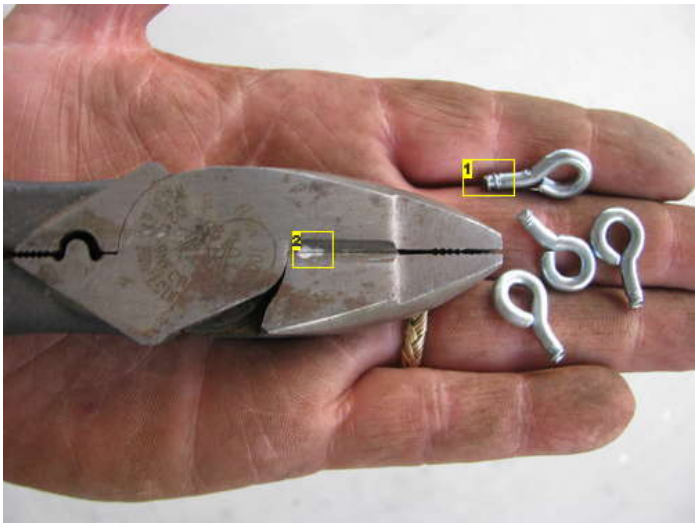


Image Notes
1. Nipped
2. Didn't hurt em one bit!

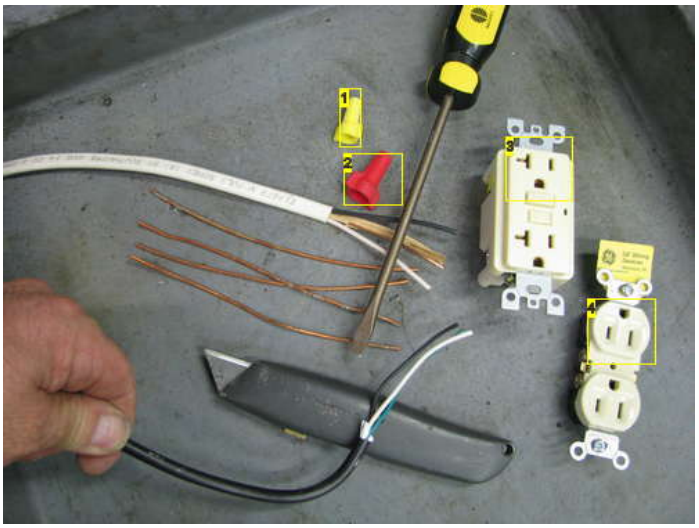


Image Notes
1. Small yellow
2. medium red
3. this is a 20 Amp GFCI. This was not used in favor of a 15 Amp version.
4. 15 Amp grounded outlet (receptacle)

Image Notes
1. Rattle can handle

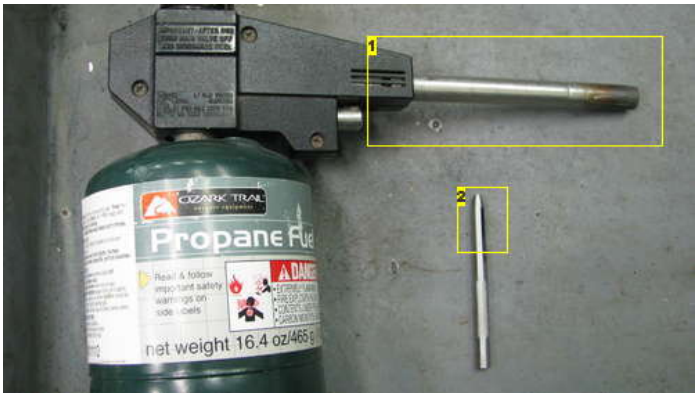


Image Notes
1. This was this torches last job. It fell off of my cart and broke. Lucky for me the flame tube broke and not the propane fitting!
2. Tapered punch for swaging the inside of the poly tube.

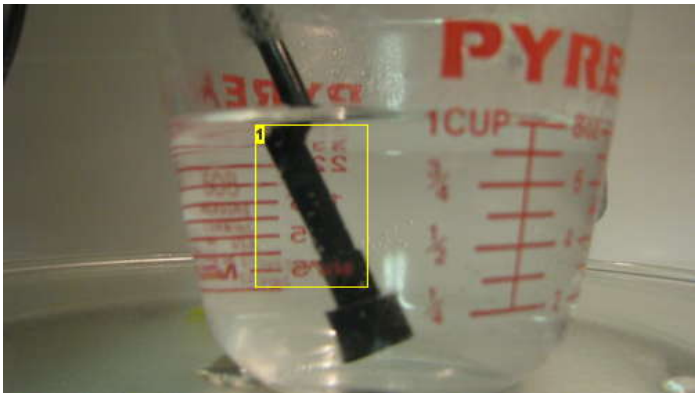


Image Notes
1. Heating the poly tube in the microwave. It took to heating and pushing cycles to get the tube all the way through the adapter.

step 2: Materials

Once again, this is not the only way to build this. Your materials will vary as you design your unit. These materials are simply the ones I needed for this version.

1. Two mini submersible pumps - about $6 ea. from Harbor Freight
(you'll only need one if this is for home (non experimental use)
Four evaporative cooler drains - $2 each - lets nutrients out of trough, back into tank
Four half inch female internal slip - 1/2" MPT - screws into drain
Four sets of plastic rain gutter caps.
A coil of 1/4" Poly micro tubing (the stuff used for drip irrigation/sprinkler systems

2. Two 10" sections of plastic rain gutter to form the 4 troughs (shown cut on the saw)

3. Two low profile plastic containers to be used as nutrient tanks - roughly 3 gallons should do it.
(you'll only need one if this is for home (non experimental use)

4. Two T12 fluorescent light fixtures - These are the least expensive ones - about $8 at Home Depot
Four 40W flourescent light bulbs.
We are using 2 plant lights (about $6 from Walmart and up to $30 elsewhere!)
and 2 regular cool white bulbs.

5. Wire nuts, short pieces of Romex wire for ground pigtails.

6. Standard lamp timer (used to turn lamps on for 18 hours (growth phase)
or 12 hours (flowering phase)
Lamp timer with 15 minute increments (used to turn pumps on for 15 minutes every 6 hour)
Three outlet grounded Right Angle Adapter - To plug in both nutrient pumps
(you'll only need one if this is for home (non experimental use)
Three outlet non-grounded Right Angle Adapter - To plug in both lights
(The standard lamp timer did not have the third ground prong)

7. Face plates for the outlets.
One 15A GFCI receptacle.
One 15A receptacle.
Two Exterior 3 hole (1/2") single gang boxes
Three 1/2" liquid tight strain relief
One 14ga, 15 amp cord (This one is 9')

8. Close up of the liquid tight strain relief

9. Sheet metal for mounting the electrical boxes.

10. A good supply of angle iron - this is 1 x 1 angle with an .093 wall.

11. Grommets to fit the Poly tube

12. Some 1/4" and 1/2" tubing to form adapters from the pump to the tubing

13. PVC cement.

14. Paint (Yep! BLUE!)

15. Screw eyes and 5/16 hardware.

16. Square drive self drilling screws - for attaching things to metal things.

17. Teflon tape

18. Aquarium air pump, tubing, fittings, air stones, and timers that will not kick off the GFCI outlet. (Air tubing fittings are only necessary for the experimental model)

During the testing I found that the mechanical timer used was tripping the GFCI outlet; so we tried electronic ones. The electronic timers were only $8 at Home Depot.

Also the mechanical timer purchased for the lighting was not grounded, and the fixtures were (who'd a thought?)

19. Plastic rain gutter hangers - as many as needed to solve the inward bowing of the rain gutters.

20. 10' of 1/2" PVC pipe

Image Notes
1. Threaded and slip
2. Drain screwed to threaded end
3. PVC pipe goes here
4. Swamp cooler or Evaporative cooler drain
5. adapter for pump

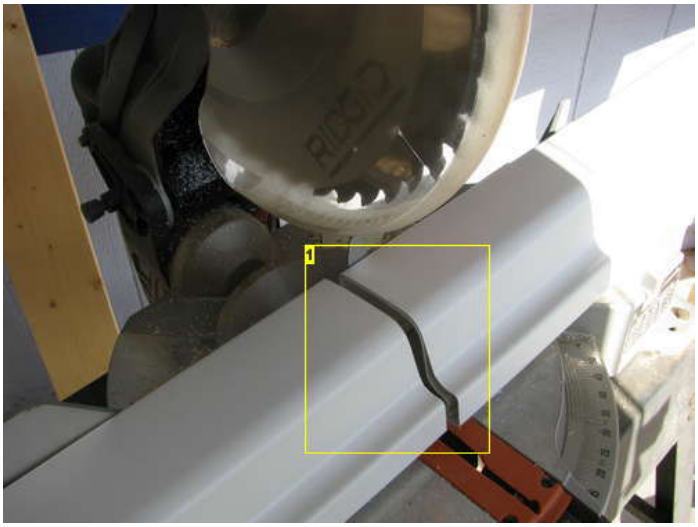


Image Notes
1. rain gutters already cut

Image Notes
1. They lie!

Image Notes
1. $6 at Walmart
2. $10 at Home Depot
3. Regular cool white $3 per pair anywhere
4. $8 each unit at Home Depot

Image Notes
1. Grounded, right angle 3 way adapters
2. This timer allows functions to be set for 15 minute intervals.

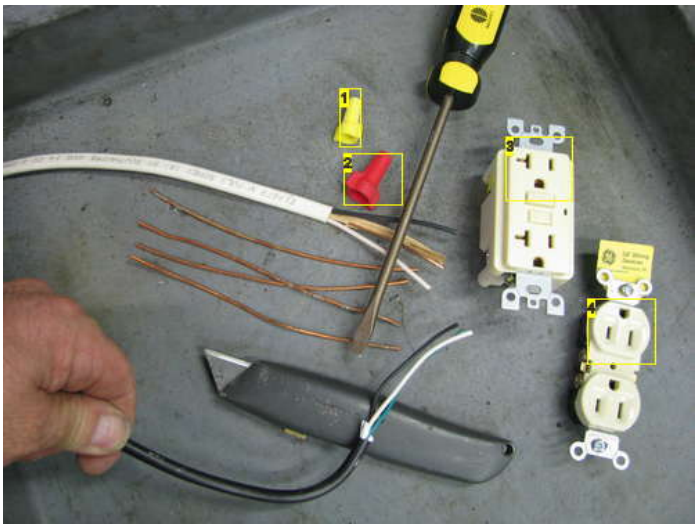


Image Notes
1. Small yellow
2. medium red
3. this is a 20 Amp GFCI. This was not used in favor of a 15 Amp version.
4. 15 Amp grounded outlet (receptacle)

Image Notes
1. This is the 15 Amp GFCI that was used
2. 14 gauge power cord for our 15 amp circuit

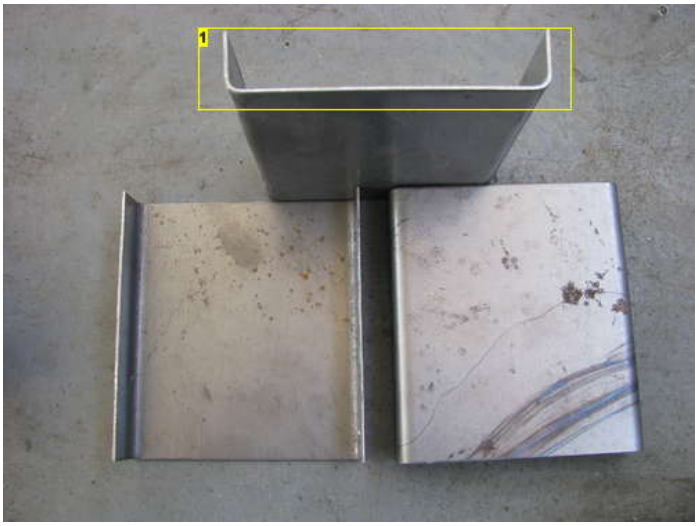


Image Notes

1. Exterior box mounts I had previously made extras of for another project.

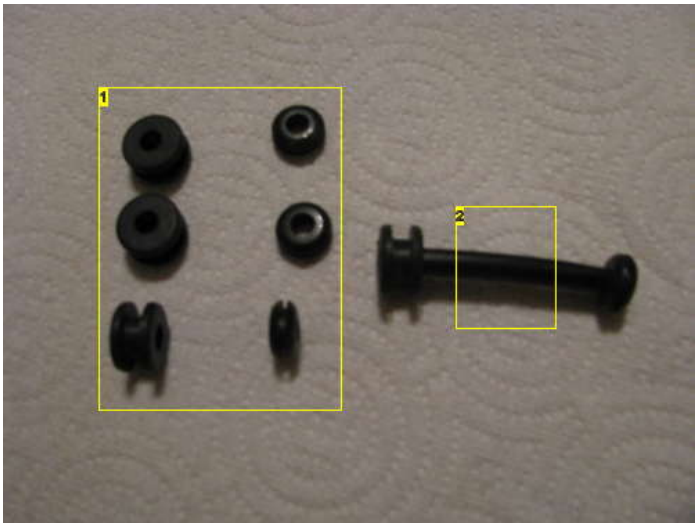


Image Notes
1. An assortment of grommets
2. A sample section of the 1/4" poly tube to check for fit

Image Notes
1. 1/2" vinyl tubing
2. 1/4" Tygon tubing, not actually used.

Image Notes
1. Red Hot Blue Glue for PVC! Gotta love it!

Image Notes
1. "D" Blue

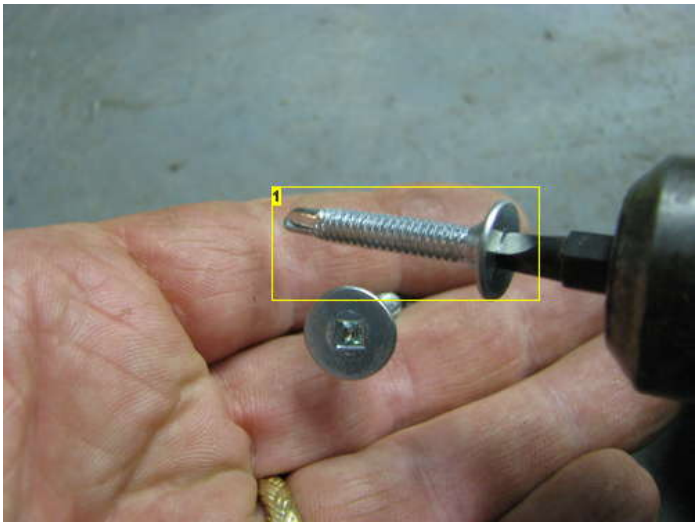


Image Notes

1. Self drilling square drive. Drill a pilot hole anyway.

Image Notes
1. Replacement timers for the one that kept tripping the GFCI outlet.
2. Aquarium stuff

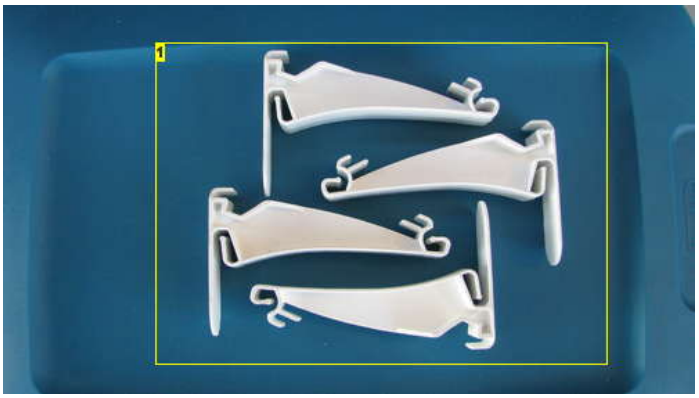


Image Notes
1. Rain gutter hanger brackets. Used to space open the tops of the troughs.

step 3: The Troughs - beginning and drain end

The troughs are made from two 10' sections of plastic (PVC) rain gutter.

1. They are measured and marked and cut in half on the compound miter box saw.

2. The end caps are fit to provide some stability, they will be glued in place later.

3. To provide clearance for the drain fitting the major diameter of the nut is measured.

4. The offset is calculated and scribed on the bottom of the gutter. - Be sure you have allowed enough clearance for the male part of the fitting on the inside of the trough!

5 The center of the bottom section is measured and marked.

6. The nut has plenty of clearance.

7. A small pilot drill is used to increase accuracy of the location and provide an easier start for the step drill.

8. The step drill is used.

9. And the hole is completed. Use the step drill on the inside of the hole as well to remove the burr.

10. Using an appropriate wrench, tighten the drain in the trough

11. During testing I found the three wraps of Teflon tape were not enough to seal the elbow into the swamp cooler drain.

Let's face it, the drain has a machine thread designed to seal on the inside of the drain for the stand pipe, the elbow has a tapered pipe thread. These two parts were never supposed to meet (Mate?).

To combat this minor problem I added 8 (yes, eight) more turns of Teflon tape to the male thread of the elbow and threaded it into the drain. After an hour - no leaks.

12. Screw the threaded elbow into the drain.

13. Using the PVC cement, install the pipe into the elbow.

14. Apply a small bead of PVC cement around the outside edge of the rain gutter and slide on the cap. This is to prevent accidental removal of the cap, rather than leaks.

15. Small bead applied.

16. When placing the trough on the frame, it may be necessary to flex teh drain pipe down beneathe the cross members.

17. Position the nutrient tank(s) beneath the four drain pipes. If you are just using one tank, turn it 90 degrees so all four drain pipes are above the single tank.

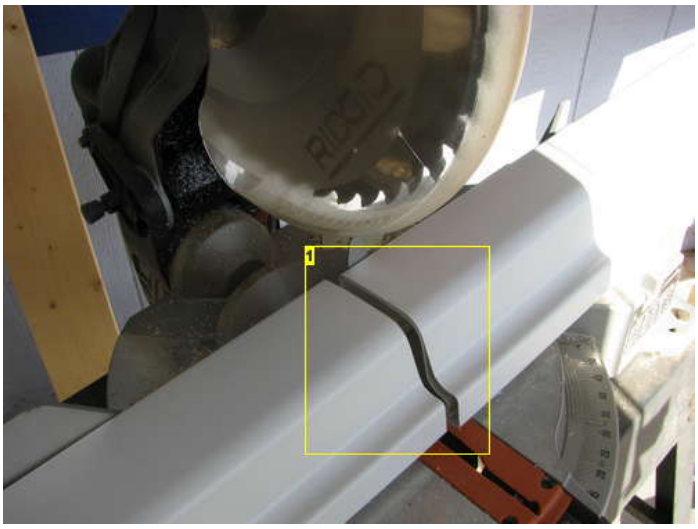


Image Notes
1. rain gutters already cut

Image Notes
1. Don't nick this gasket

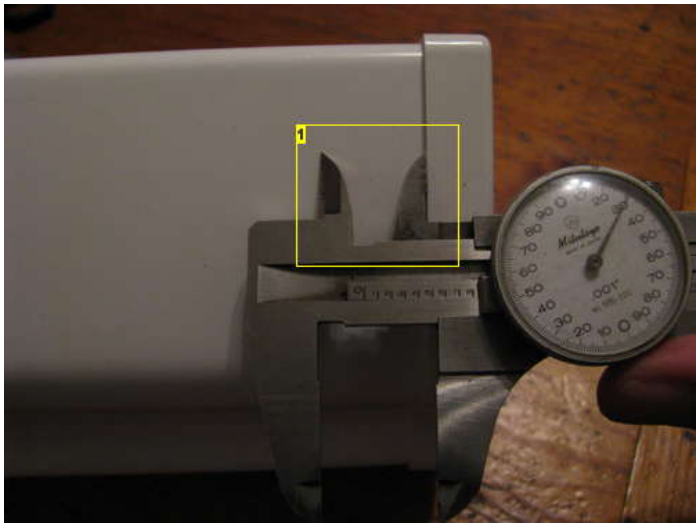
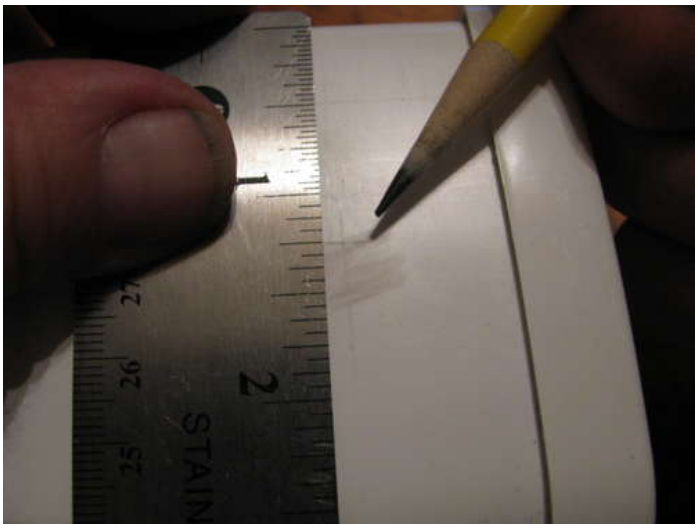
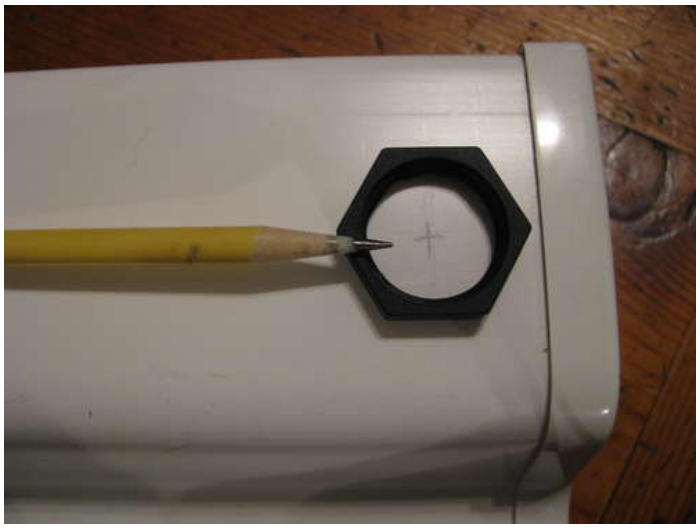


Image Notes
1. measuring the offset for the drain





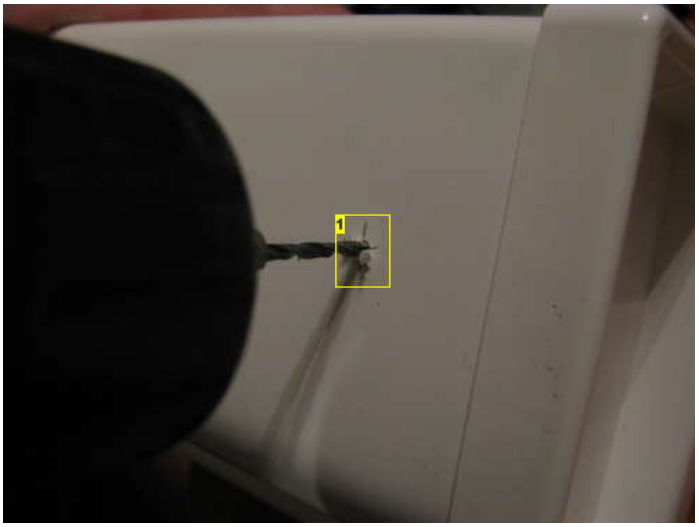


Image Notes
1. Drilling the pilot hole

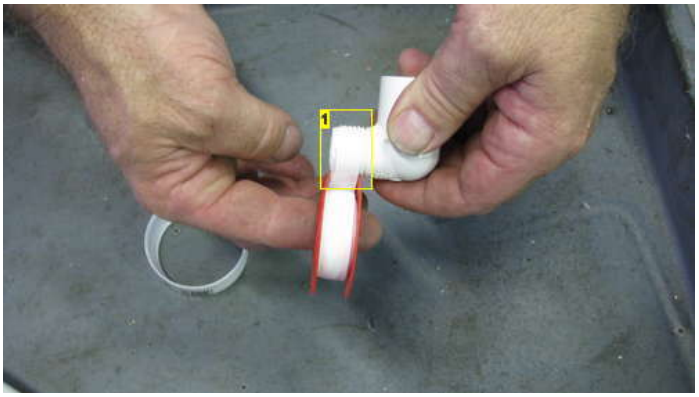
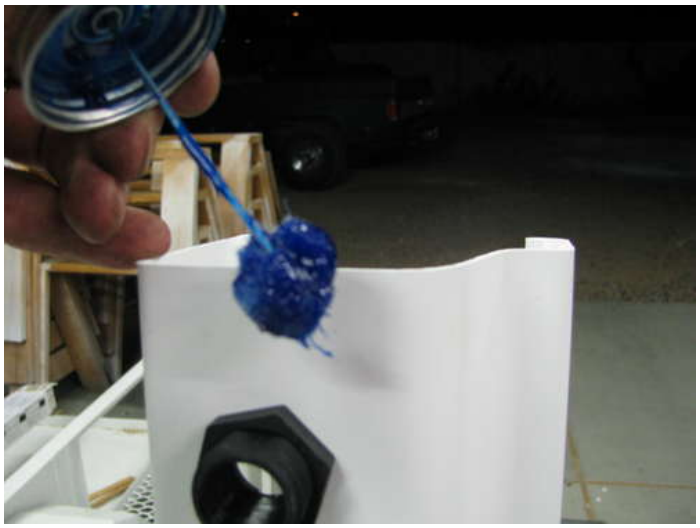


Image Notes
1. 3 wraps should have been enough... it would have been if it were 2 pipe threads.



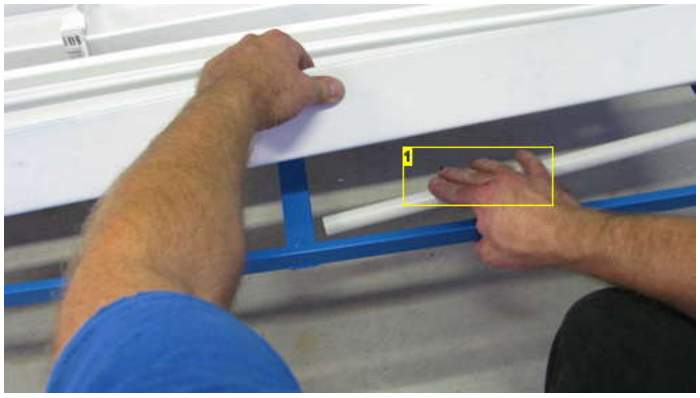


Image Notes
1. Flex the drain pipe down to get it under the cross brace

step 4: The Troughs - supply end

The nutrient supply will enter through the end cap on the high end of the trough.

1. The nutrient supply hose (1/4" drip line / sprinkler hose) will be held in place by a grommet in the end cap. We will determine which grommet to use based on the wall thickness of the end cap.

2. An 11/32" hole is drilled through the cap, deburred, and the smaller grommet is selected.

3. The grommet is then installed in the hole to provide retention for the supply line. You are looking at the inside of the end cap.

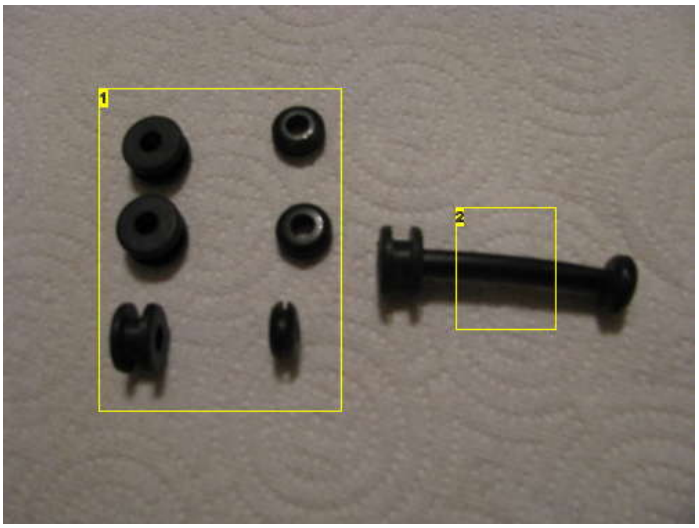


Image Notes
1. An assortment of grommets
2. A sample section of the 1/4" poly tube to check for fit

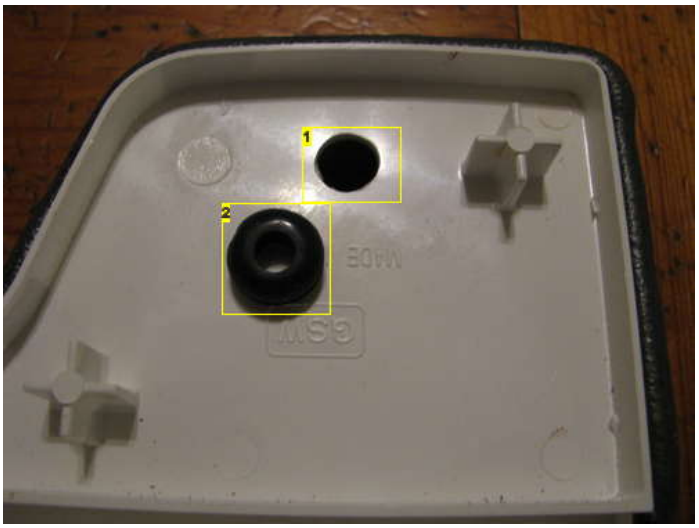


Image Notes
1. 11/32" hole through end cap
2. grommet to be installed

Image Notes
1. Grommet in place

step 5: Frame

The frame is pretty straight forward. The outside dimensions are 60-1/2" long by 23" wide. The counter it will live on is 24" wide and I need to leave 1" of clearance for the light brackets.

1. Cut angle iron

2 - 60"
2 - 23"

Set the 60" pieces inside and on top of the 23" pieces. Use a tape measure (or two) to square up the frame. Do this by measuring form corner to corner as show. Adjust the frame until both dimensions are the same.

2. Tack the inside corners (ONLY) so you can make any adjustments necessary.

3. Recheck the frame to make sure it is square and weld the corners solid.

4. Cut two cross braces 23" long and trim both ends of one leg to 45 degrees. This will eliminate a sharp edge when someone reaches under to change the nutrients or perform other maintenance. It also gives your ends a finished professional appearance.

(Note: save the triangles that fall off. They will come in useful later!)

5. I put the frame up side down on some old fence blocks to make installing the cross braces easier and because it will make it easier to check the height for the legs later. Measure the frame 20" from each end and clamp the cross braces as shown

6. Weld the cross brace to the from from the outside. (The frame had been flipped right side up in this picture.

7. Add a small weld on the inside for additional strength.

8. As I goofed and had to shorten my troughs two inches, this is an additional cross brace to support the ends. In making lemon-aid, it will also allow for some curvature of the nutrient feed tubes.

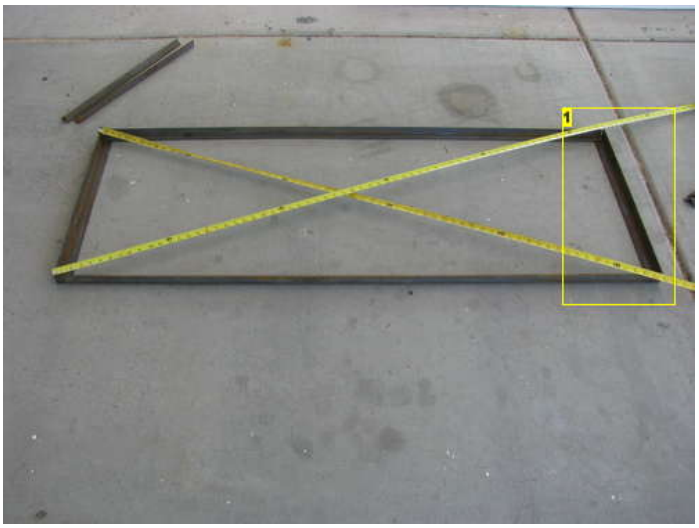


Image Notes
1. Check corner to corner for square

Image Notes
1. Tack on inside so you can re-square the frame if necessary

Image Notes
1. Pretty darn close to perfect!

Image Notes
1. Trin the ends at 45 degrees for safety and a professional look.

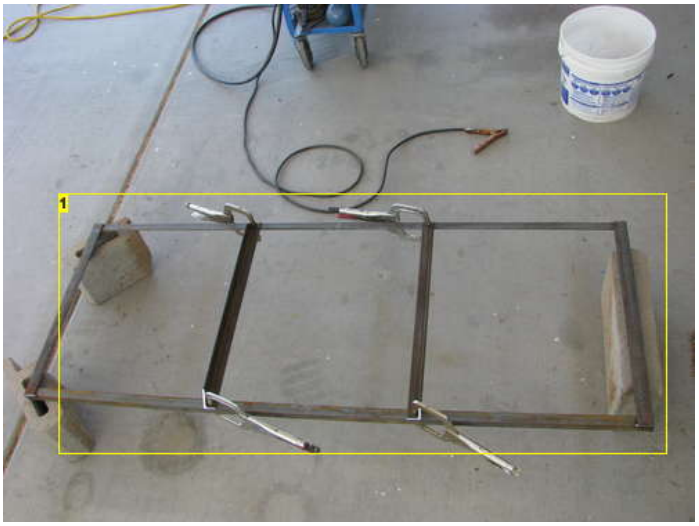


Image Notes
1. Flipped and raised for ease of welding

Image Notes
1. I usually run the weld off onto the base metal to avoid melting off the corner

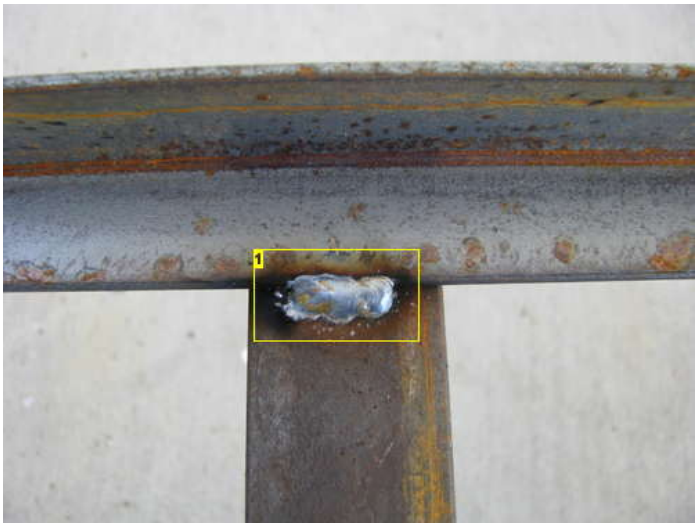


Image Notes
1. Small weld on the inside, top edge.

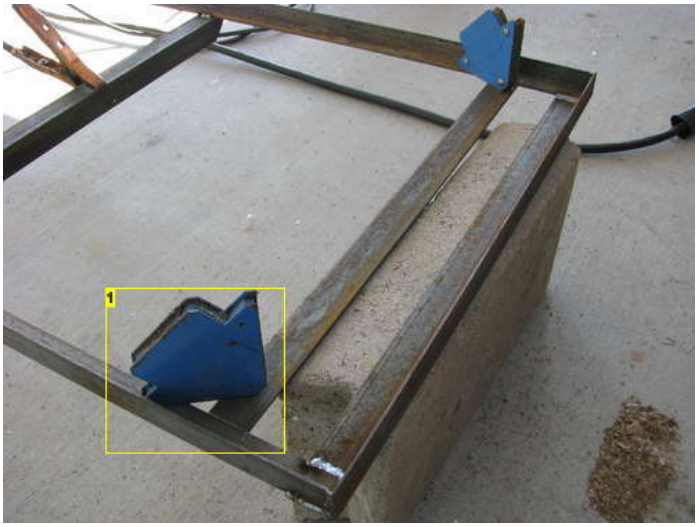


Image Notes
1. Welding magnets - good for this lightweight, flush surface type of holding

step 6: Legs

1. Place one of the nutrient tanks under the frame and the trough with the drain in place. Measure the distance from the bottom of the drain to the top of the tank. Add this to the height of the frame from the ground. This will be the length of your short legs. Add two inches to the length of the short legs to get the length for the long legs. Be sure to add in an inch or so of clearance for safety sake.

Cut to of each length:
My short legs are 8"
My long legs are 10"

2. Flip the frame upside down on the fence blocks. Position the legs and hold them with magnets. Note: I positioned the legs lightly inside of the frame so as to give the weld a lower profile. Weld the legs to the frame.

3. Flip the frame right side up, stand back and admire your work!

4. Slide a nutrient tank underneath and a trough with a drain on the frame and make sure you have enough clearance. (sorry for the cluttered background)

Image Notes
1. Measuring minimum clearnace height.

Image Notes
1. Slightly in-set to blend the welds more easily.

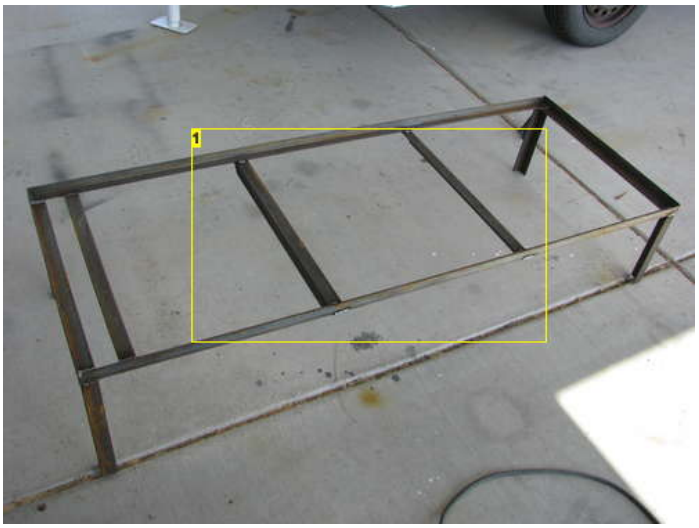


Image Notes
1. Finally standing on its own!

Image Notes
1. Height verification

step 7: Rear Brace

The rear brace will serve two functions: It will stabilize the long dimension of the frame and also provide a second point to anchor the light brackets. You will now have to decide which end will be the left side and which is right

1. Measure a piece of angle iron to fit inside the legs. Mine was 60"
Mark the legs 1" up from the bottom.

2. Clamp the rear brace inside the back two legs and weld it in position.

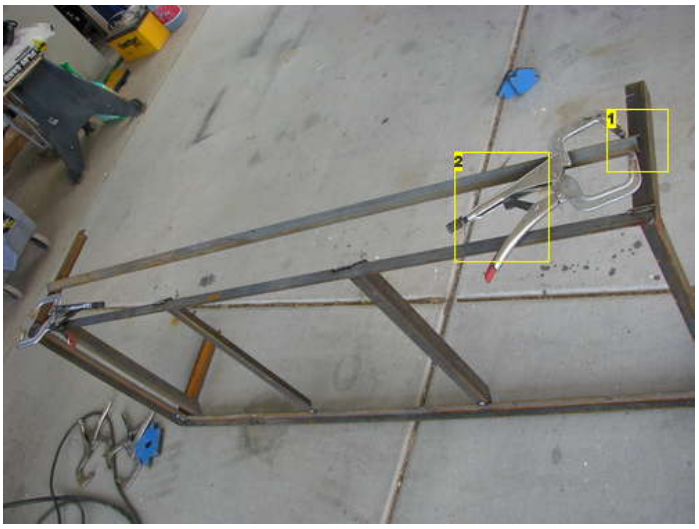


Image Notes
1. Length of angle iron should be just inside of legs.
2. These are not clamping anything, just laying there waiting to be used.

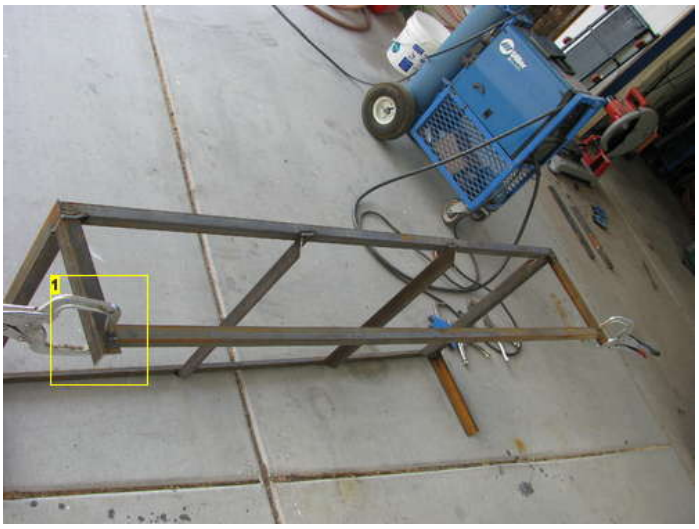


Image Notes
1. Clamped and ready to be welded.

step 8: Light Bracket Uprights

The light brackets will be easily removable for storage. They hold the two fluorescent fixtures above the troughs. The chains suspending the lights will also allow adjustment of the height of the lights for optimum growth.

They slip onto the lower rear brace and are bolted to the top rear frame. As the rear brace is parallel to the ground and the top frame is not; one light bracket is 2" longer than the other. This maintains the same distance to the troughs over the length of the frame.

1. Lengthwise. The frame is 5' long and the fixtures are 4' long. That leaves 6" between the frame and the fixture. The chains are 1-1/4" from the end so my measurement from the end of the frame is 7-1/4".

2. Front to back. The frame is 23" and the fixtures are about 5" each. That leave approximately 4-3/8" spacing.

3. The bottom brace on the frame is marked for lengthwise dimensions - 7-1/4" from each end.

4. The uprights are cut 48" and 50" long. The longer one belongs on the high side of the frame. The uprights for the brackets are clamped in place, square with the bottom brace. This should make them plumb (if it's resting on a level surface, not my driveway.)

5. The upper frame and lower brace are marked for easy referance.

6. Remember those neat little triangles that dropped off from trimming 45 degree angles on the cross braces???

7. They make dandy stops for the uprights. Center one on each upright, against the top of the rear brace.

8. From the back side of the upright, carefully tack the stop to the upright. Then remove it and carefully weld the tip of the triangle to the front of the upright.

9. Cut two 4" pieces of angle for retainers, mark the center and clamp each retainer to the stop on the uprights.

10. Carefully weld each retainer to the stop. This will allow the upright to slide off of the rear brace and to be easily slid on. It will eliminate the need for a bolt on the bottom. You could actually use this method for clamping the upright to the top of the frame as well, but I chose to bolt it for security.

11. Mark, center punch and pilot drill the uprights and frame.

12. Clearance drill the piloted holes 21/64" to allow for a 5/16-18 bolt.

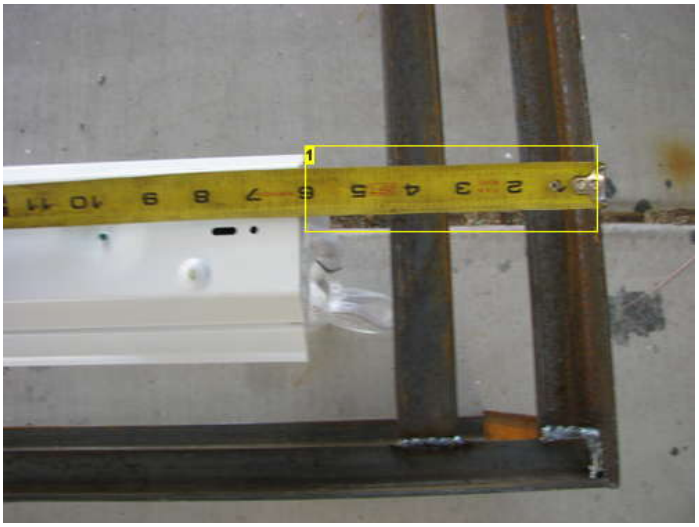


Image Notes
1. Measuring lengthwise offset.

Image Notes
1. Measuring front to back offset.

Image Notes
1. Rear brace marked

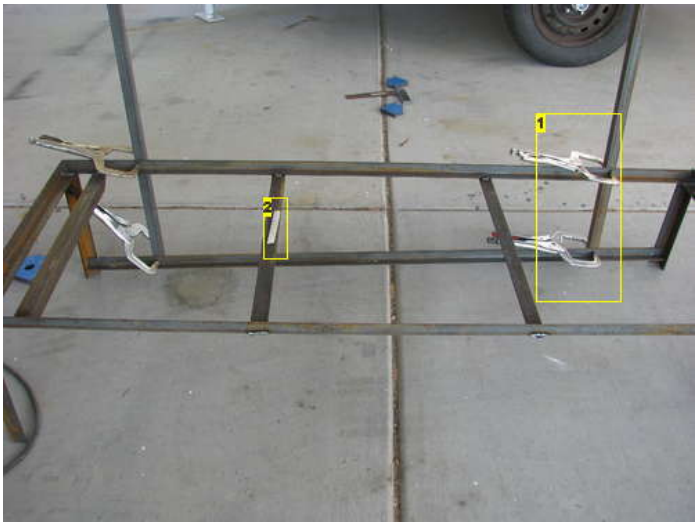


Image Notes
1. Clamped in position
2. Handy, dandy soap stone

Image Notes
1. Mark rear of frame for referance.

Image Notes
1. Very useful drop off! Save em!

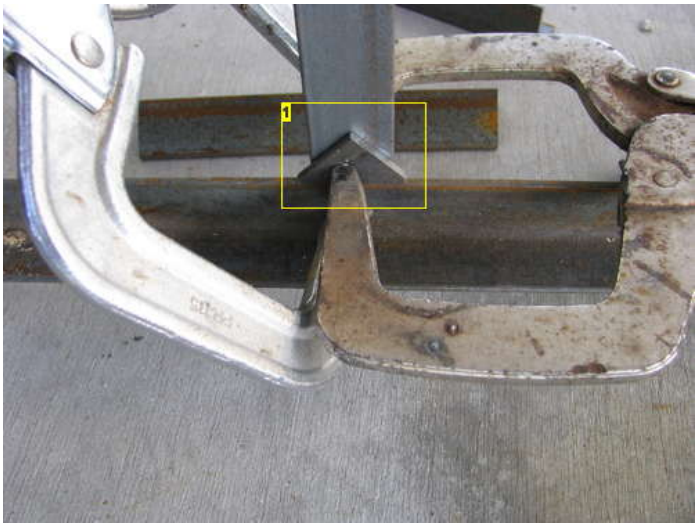


Image Notes
1. Drop off used for a spacer.

Image Notes
1. Corner of useful triangle drop-off tack welded.

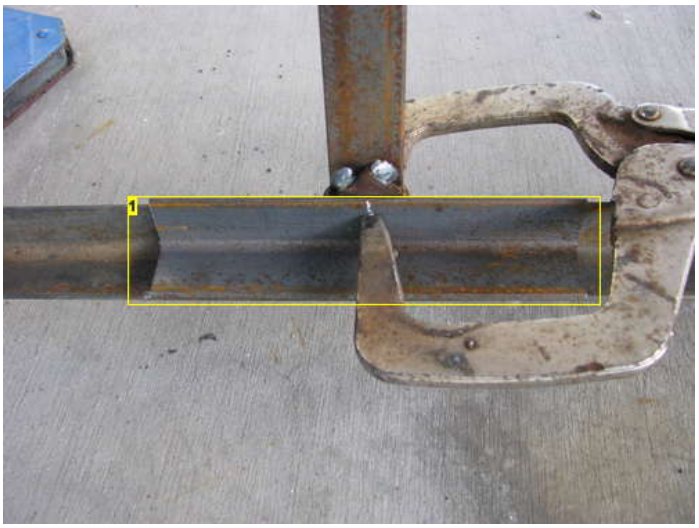


Image Notes
1. Retainer marked, clamped and ready to be welded to the spacer.

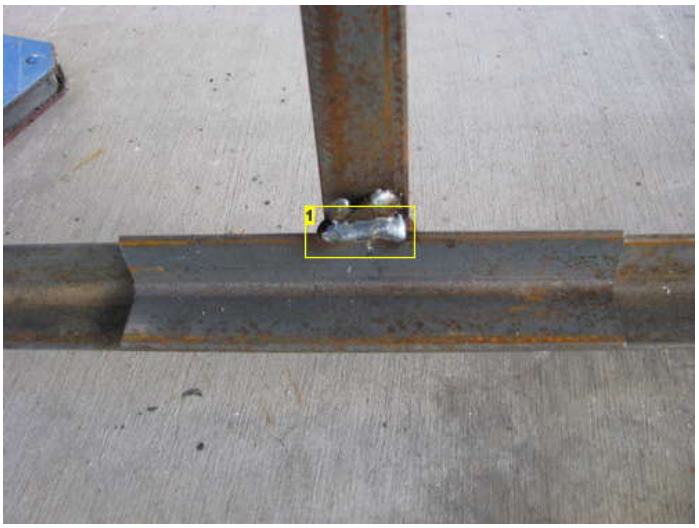


Image Notes
1. Welded

Image Notes
1. Pilot hole

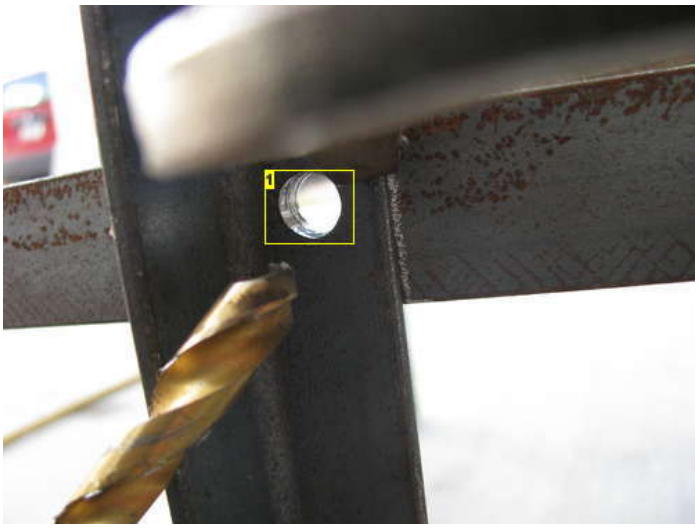


Image Notes
1. 21/64" clearance hole for 5/16" bolt

step 9: Light Bracket Arms and Chain Mounts

The Light Bracket Arms will stick out from the uprights and provide a place to weld the chain mounts.

1. Cut two pieces of angle iron 18-1/2" long. Clamp the two pieces together. Using a square, make a mark 1-1/4" from one end, and a second 9" from the first. This will provide spacing for the lights.

2. Using a pair of linesman pliers, cut off the threaded portion of the screw eyes.

3. Using a small welding magnet, position the screw eye on the mark, center and align it and tack weld it in place. Repeat this for the other three screw eyes/chain mounts.

4. Unclamp (careful it's hot!) and offset the chain mounts to provide access all around each base. Clamp them back together for ease of handling.

5. To complete the welding, make a second tack opposite the first tack. For the third side of the mount, strike an arc on the angle and run a short bead past the base of the mount. The arc should just brush against the mount to weld it fast. Repeat to weld the fourth side of the mount. Do not try to run a bead in a circle around the base of the mount; the mount will overheat and melt off.

6. Position the arm on the upright using a large welding magnet. Put the two flat legs of the angle together.

7. Tack weld the arm to the upright in the back.

8. Check for square, adjust if necessary and weld into place.

9. Take a picture of the huge beetle on your saw horses. BTW that is 1/2" plywood.

10. Using a pair of needle nose pliers and the cheesy chain that came with the light fixtures, spread open the end link and hook it over a chain mount.

11. Using the needle nose pliers, squeeze close the link so the chain is captive on the chain mount.

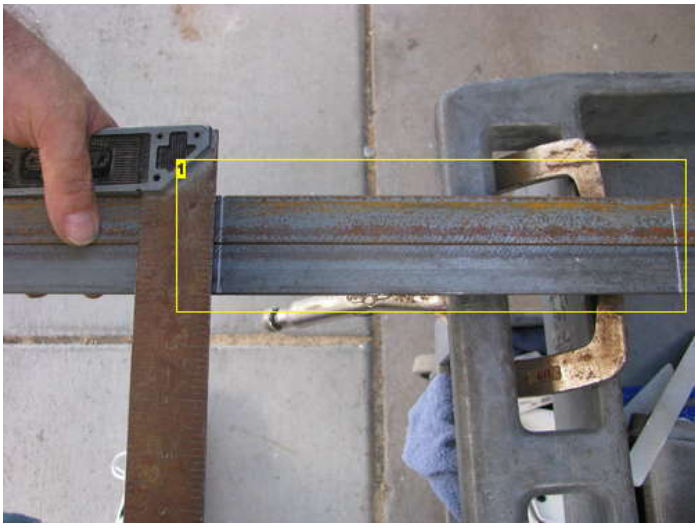


Image Notes
1. Marking for correct light spacing for front to back

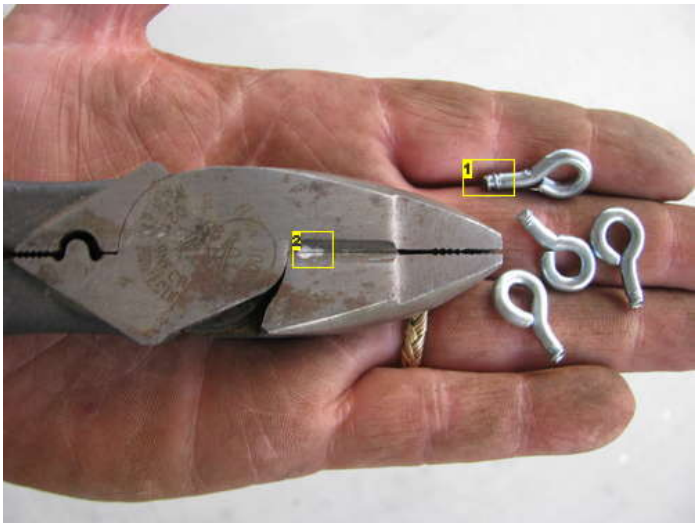


Image Notes
1. Nipped
2. Didn't hurt em one bit!

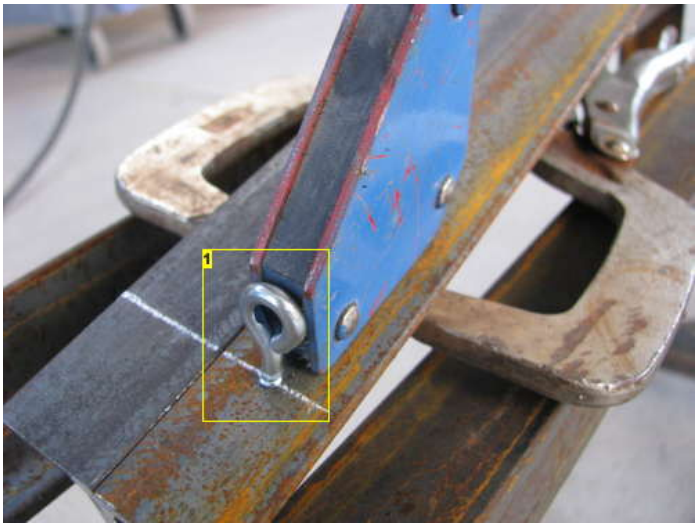


Image Notes
1. Positioned

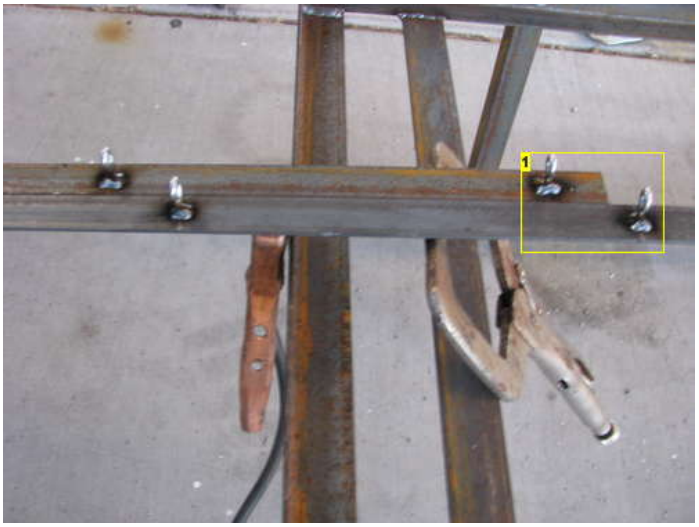


Image Notes
1. Welded

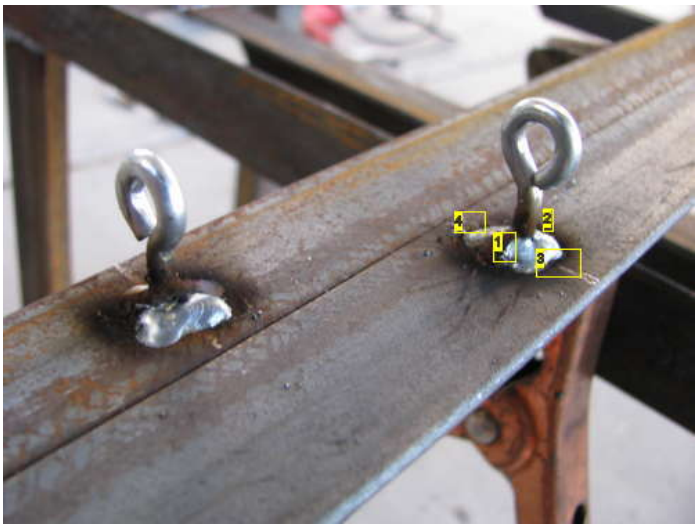


Image Notes
1. 1st tack
2. 2nd tack
3. 4th pass - small bead
4. 3rd pass - small bead

Image Notes
1. Holding the arm in position

Image Notes

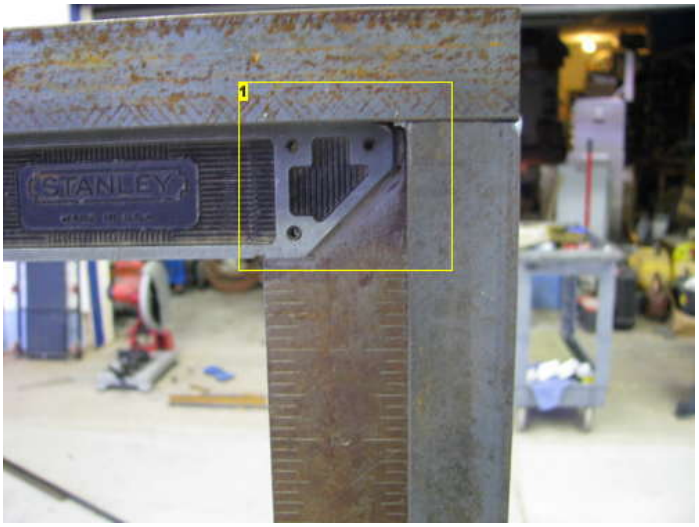


Image Notes

1. tacked

Image Notes
1. This is 1/2" plywood

1. Double check square

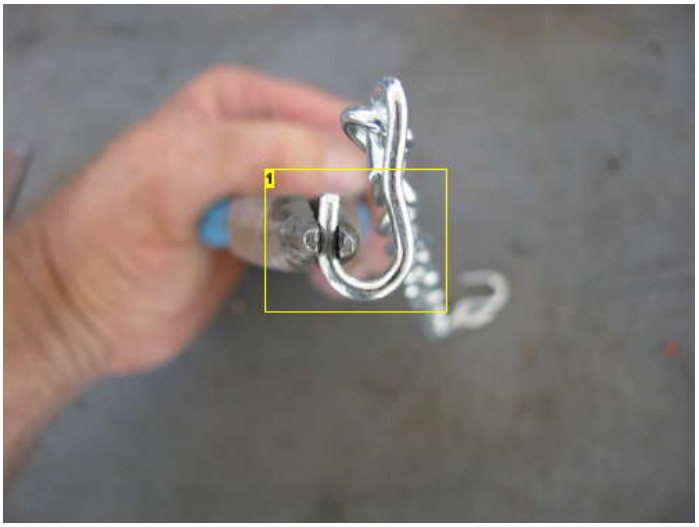


Image Notes
1. Open the end of the chain

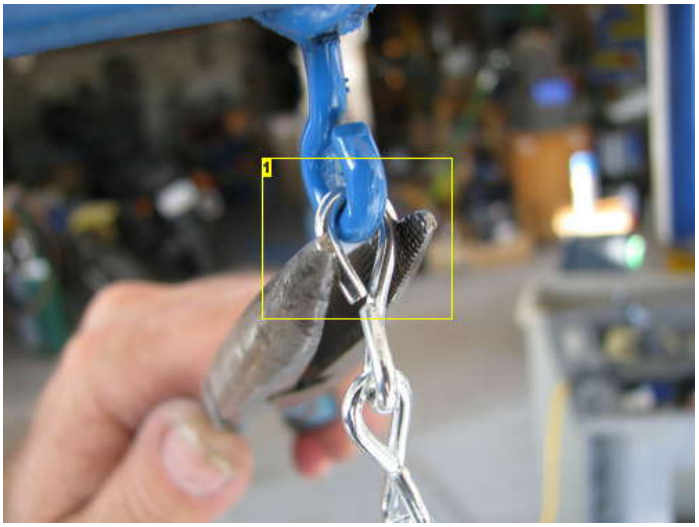


Image Notes
1. Close the link on the chain mount (after painting of course)

step 10: Control Panel

As I mentioned in the Introduction, the control panel was converted from one double gang box to two single gang boxes. The original double gang box (while simpler) did not allow us to plug in both timers.

1. This is the control panel in its final configuration.

2. The three square mounting plates are 12 ga. steel formed into a 4-1/4" long x 4-/2" wide "C" channel with a 7/8" leg. I just happened to have them kicking around but their convenient size was not a coincidence. They were left over from building my driveway cover and were used (or not used) to install single gang exterior outlet boxes. Just like the ones we are using here. I always try to make a few extra of anything I'm making, and once again it came in handy.

3. On both single gang boxes, using the enclose hardware, mount the mounting tabs on the boxes. Be careful not to over tighten and strip the threads in the box. (I personally think this mounting system leaves much to be desired, but you are not supposed to drill through the back of the box and use real bolts)

4. Install the plugs in the back of both boxes and in the bottom of one of them.

5. Position, align and square up one of the boxes on your mounting plate.

6. Using a sharp pencil (or other marking device) mark the hole locations on the mounting plate

7. Using a sharp center punch, punch the centers of the circle.

8. Using the correct size drill bit, pilot or clearance a hole for the screw you will be using. I have square drive self drilling screws and my pilot size is 9/64".

9. Set the box over the piloted holes and insure alignment.

10. Cut two 14" pieces of angle iron and trim opposing legs at 45 degrees for functional and aesthetic purposes. Remember to save those useful triangles!

11. Mock up the control panel and measure for the cross braces. Mine were 12-3/8".

12. Cut two cross braces 12-3/8" long. Hold the top brace in position with welding magnets and use the second brace for spacing. Tack weld and check square.

13. One at a time, position the three mounting plates and tack in position. Be sure to check square as you go.

14. position the lower cross brace as show, tack in position, check square and parallel. Weld the entire assembly. Clamp the welded control panel to frame.

OPTION #1 - If you do not need this to be low profile in storage, weld the control panel in place and go onto the wiring step.

OPTION #2 - If you need this to collapse into the smallest package possible, go onto the next step.

15. While the control panel is clamped to the frame, mark, punch and pilot drill for clearance holes.

16. Use the proper clearance drill, open the holes up to the clearance size.

17. Be sure you do not catch the drill tip as it breaks though. Man that was a good split point, TiN coated drill!

Using 5/16" bolts and nuts, fasten the control panel to the frame.

18. Bonus Picture! - The old control panel cut off!

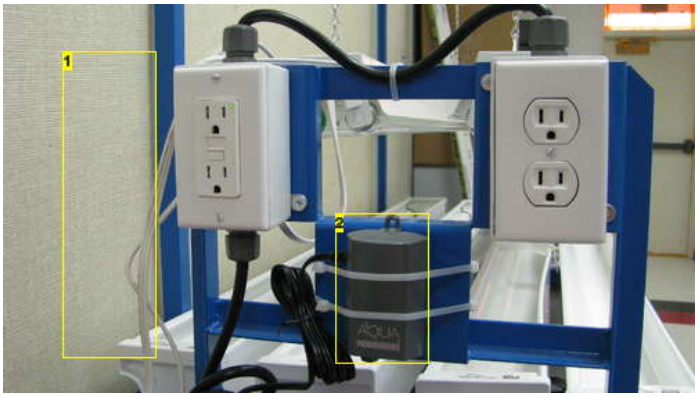


Image Notes
1. Final version of control panel
2. Aquarium air pump and cable ties

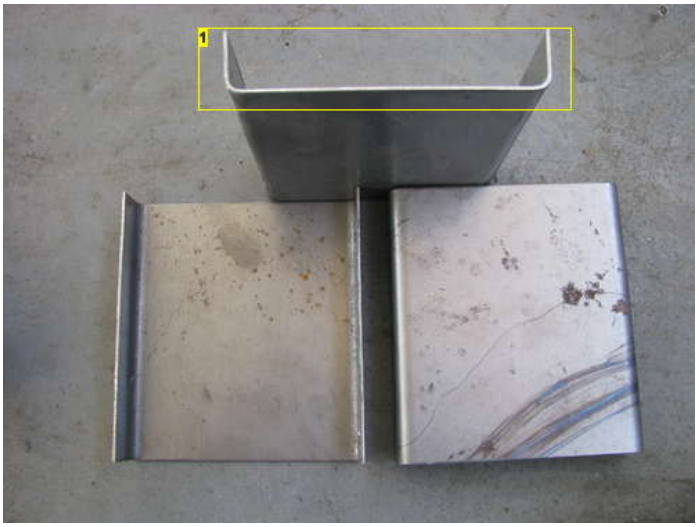


Image Notes
1. Exterior box mounts I had previously made extras of for another project.

Image Notes
1. Don't overtighten this little bugger. You'll strip it!

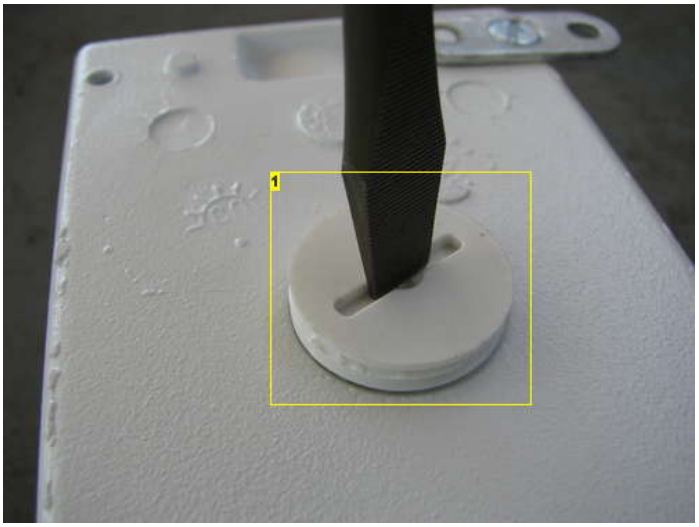


Image Notes
1. Install plugs in un-needed holes.

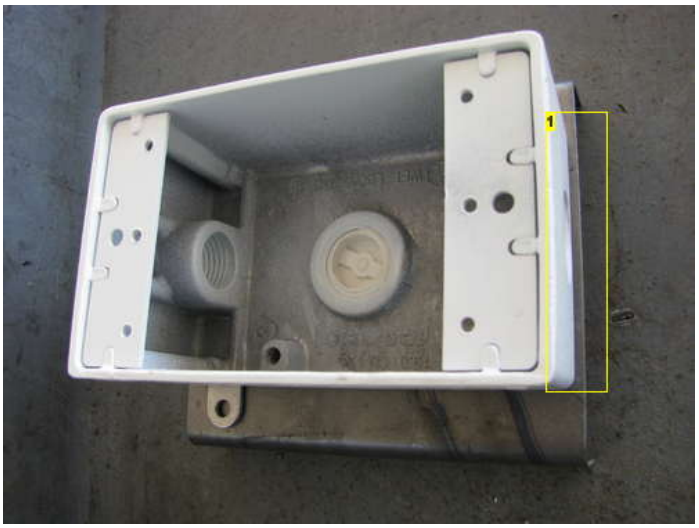


Image Notes
1. Centering and aligning box on mount

Image Notes
1. Mark hole locations

Image Notes
1. Center punch hole locations so your drill bit doesn't walk.

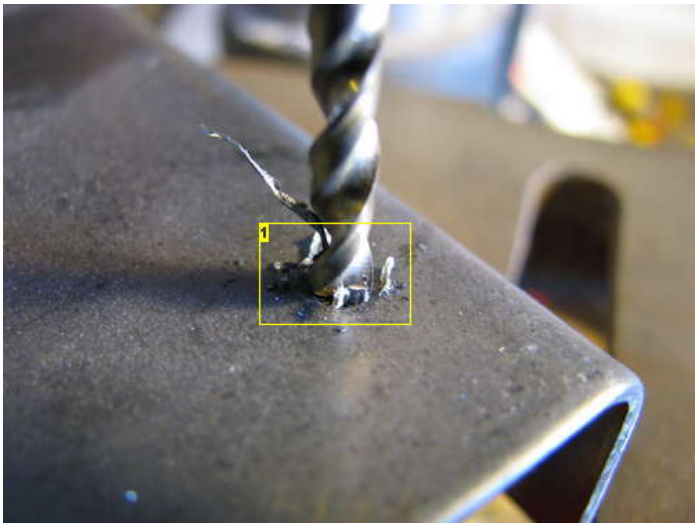


Image Notes
1. Pilot drilling for self drilling screws. It just makes life easier and more accurate!

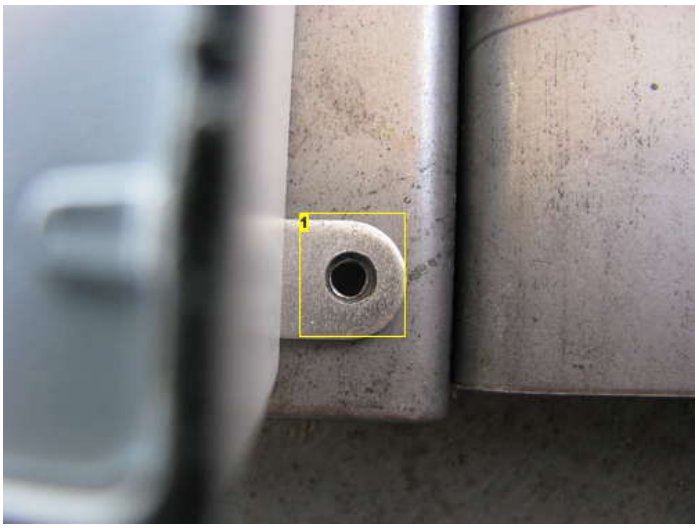


Image Notes
1. Lined up pretty close

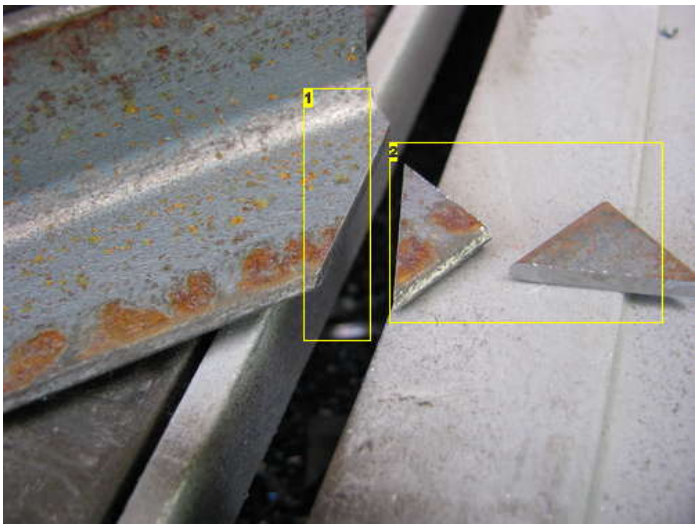


Image Notes
1. More professional safe edges
2. More useful triangles

Image Notes
1. Measuring for cross braces

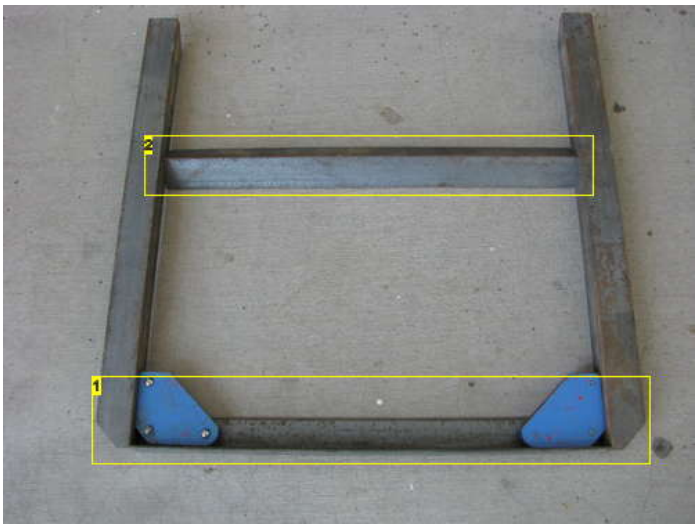


Image Notes
1. Upper brace held in place, ready for tack welding.
2. Lower brace just being a spacer for now.

Image Notes
1. Measuring for cross braces

Image Notes
1. Clamped in place and ready to be drilled.
2. Paint removed because I thought it was to be welded. My wife wanted it removable for storage.

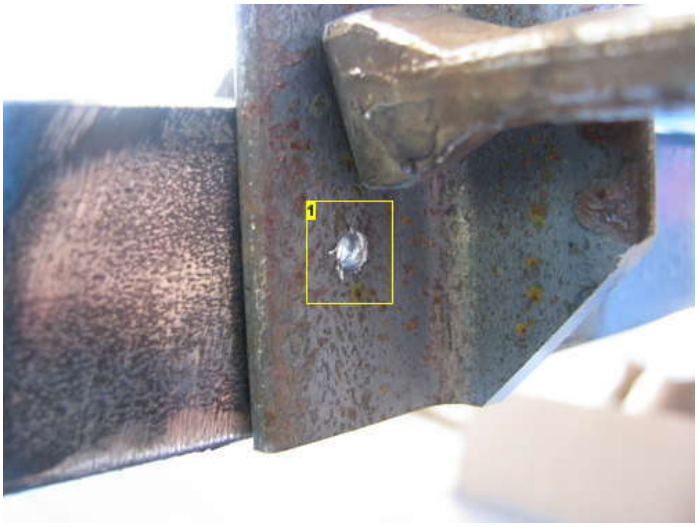


Image Notes
1. Piloted

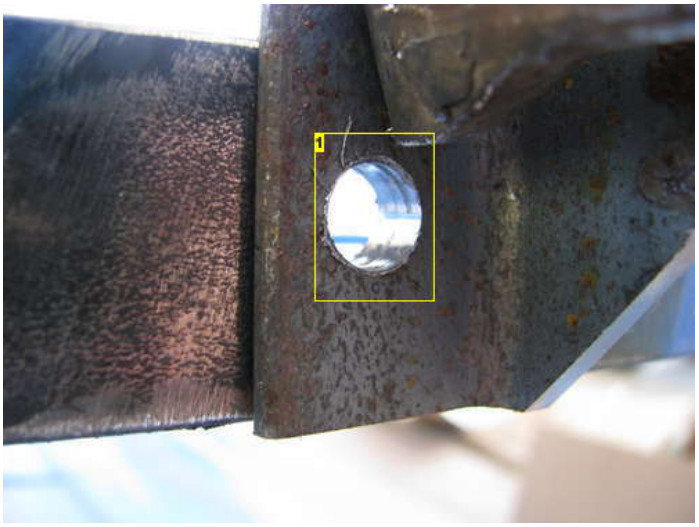


Image Notes
1. Clearance hole

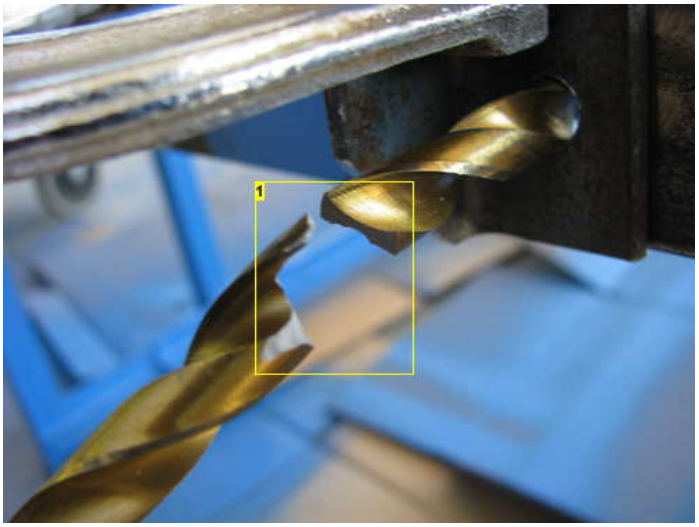


Image Notes
1. The mark of a high quality drill bit; shattered instead of bending.

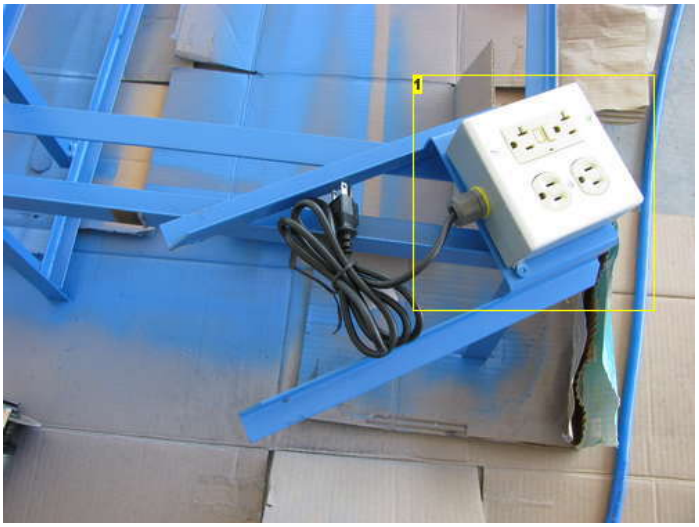


Image Notes
1. This was the first one.

step 11: Prep for wiring the control panel

I did as much wiring as possible prior to mounting the gang boxes to the control panel. This allowed me to work at a comfortable height, without bending over for extended periods of time.

1. Remove the lock nut from the strain relief. Save that little bugger, you will need them later in life.

2. Remove the cap, strain bushing and seal from the base of the strain relief assemblies. By hand, thread the bases into the empty holes in the gang boxes (two tops and one bottom) then tighten them with a wrench. Do not over tighten, just until the gasket compresses slightly.

3. Slide the cap, seal, and strain bushing onto the wire, through the bushing base and into the gang box. Do not tighten.

4. Measure the center to center distance of the mounting plates on the control panel, mine was 9". Separate the gang boxes by that amount and pull the appropriate amount of wire. Cut off the rest of the wire for the plug, slide on the cap, seal and strain bushing and pull the wire thought the bottom of the first gang box.

5. On all three strain relief bushings, press the seal into the strain bushing, press the subassembly into the bushing base and then screw on the cap. Tighten by hand only.

6. This is what the assembly should look like.

7. Note the warning label on the power cord. <sarcasm> Boy am I glad I'm not a pregnant woman in California! </sarcasm>

8. Now is a good time to install the ground screws. Just put them in a half turn or so, you will tighten them later.

9. Strip the outer insulation jacket from the cable without nicking the inner insulation.

Then strip the appropriate length of insulation from each wire. See step 10.

10. Use the strip gauge on each device to determine how much insulation to remove from each wire.

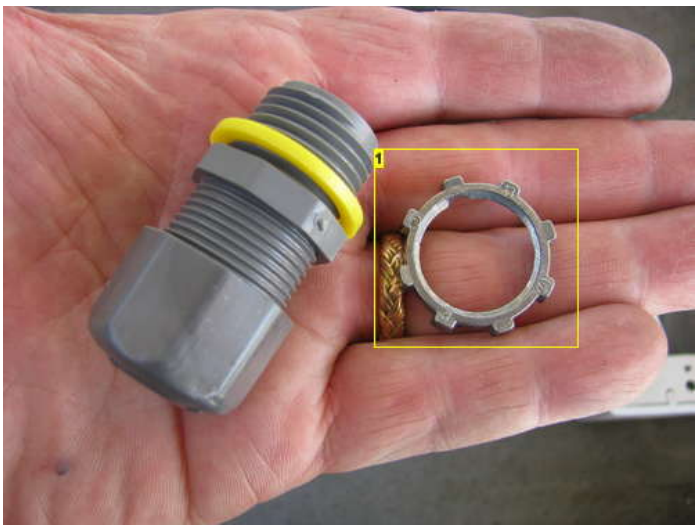


Image Notes
1. You don't need this now, but you will for a future project!

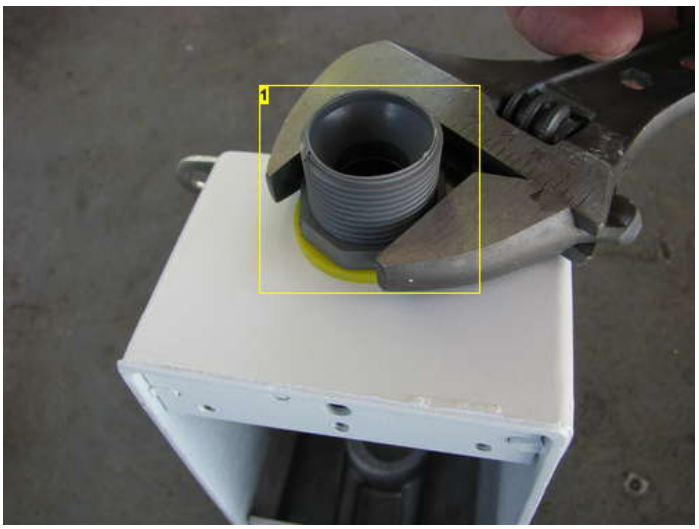


Image Notes
1. Snug this down until the yellow washer/seal just slightly compresses.

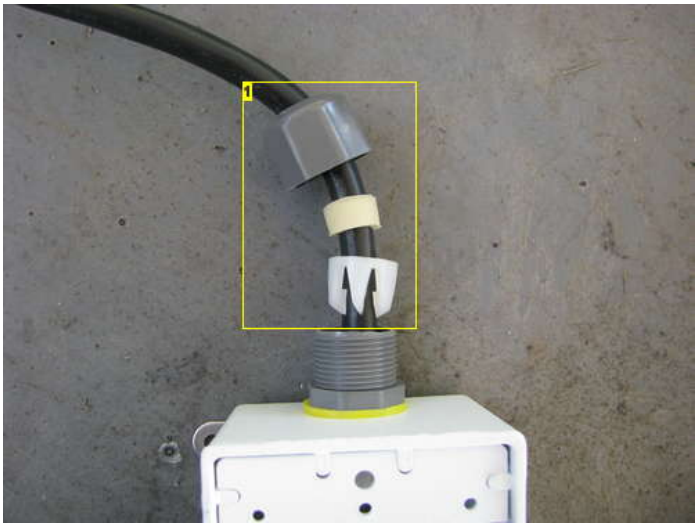


Image Notes
1. Don't forget to thread these parts onto the wire before making your connections.

Image Notes
1. Measure the spacing of the control panel and make sure you leave enough wire.

Image Notes
1. Seal pressed into strain relief.

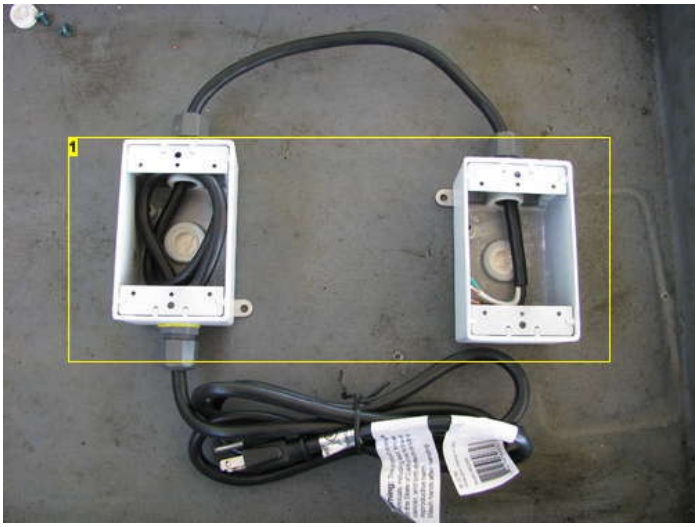


Image Notes
1. Wires cut to length and strain relief tightened.

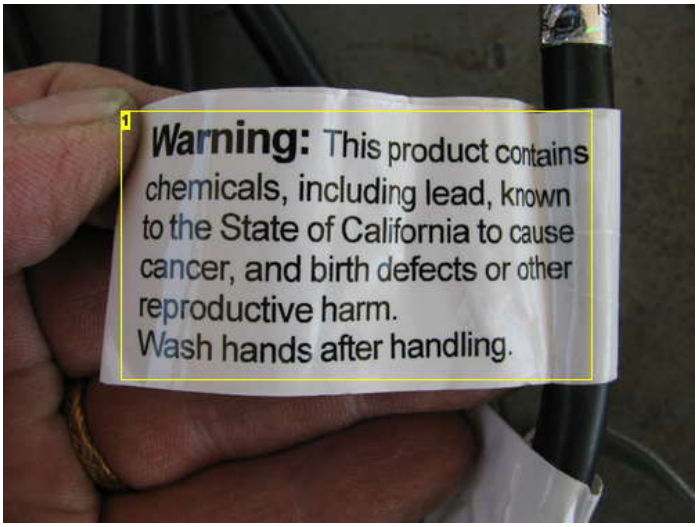


Image Notes
1. Glad I live in Arizona!

Image Notes
1. Install ground screw loosley

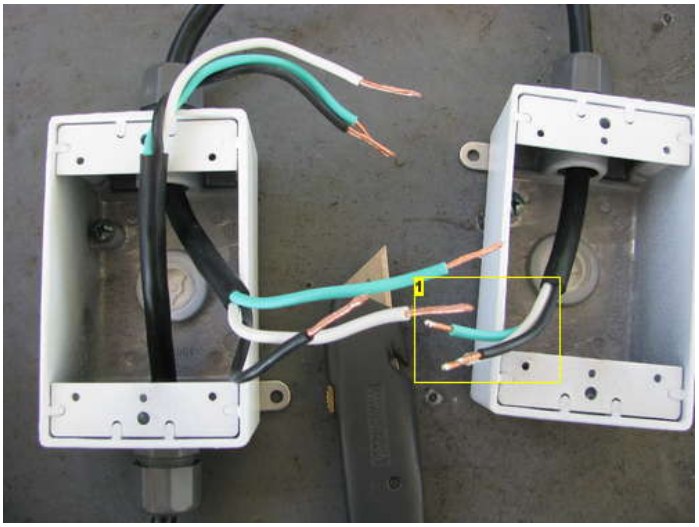


Image Notes
1. Strip outter jacket and inner insulation.

Image Notes
1. Strip length should match strip gage on the back of the device.

step 12: Wiring the control panel

As this is definitely a wet location with a high probability of a student splashing, a GFCI is MANDATORY for this installation. GFCI stands for Ground Fault Circuit Interrupt and will shut the power off if there is an imbalance in the power between the black and white wire (hot and return).

For whatever reason, I usually start wiring at the end of the run. In this case I started with the plain grounded receptacle in the right hand gang box.

Remember when connecting the wires to the devices...

Black is Brass
White is Silver

Also, as this is stranded wire, you cannot use the "stab-n" connections in the back of the receptacle.

1. Wrap the black wire around the brass screw in a clockwise direction and tighten. This is code and it is important so the wire tightens around the screw as you tighten the screw. (Yes this is a used receptacle being put back into service. Hooray for recycling!)

2. Wrap the white wire around the silver screw and tighten. Make a pigtail by cutting a 6" piece of 14 ga. copper from some scrap romex (or whatever type of wire you have kicking around), put a "U" bend in the end and place it clockwise around the ground screw. Tighten the ground screw.

3. Install another pigtail on the ground screw on the receptacle

4. Hold all of the grounds together.

5. Using a linesman plier, twist them together and trim the ends flush and install a yellow wire nut.

6. Using a screw driver, install the receptacle in the box.

7. Do not tighten the screws. Leave them 2-3 turns loose. This will enable you to properly tighten and center the face plate.

8. Use a flat blade screwdriver to start the screw in the face plate. Straighten and align the plate on the edges of the box and tighten the screw.

9. Inspect the back side of the GFCI. One set of holes is for the line (power in) and the other set is for the load (power out for the other receptacle) DO NOT MIX THEM UP! On a new GFCI there will be a label over the line side of the device.

You can use the stranded wire in these holes. These screws tighten the conductor between two flat plates so stranded is OK. If you have trouble inserting the wires, check that the screw is loose and that it is pushed up against the side of the device.

10. With respect to polarity, install the wires from the plug side into the line side of the GFCI and tighten the screws. Install a pigtail on the ground screw in the box and tighten.

11. With respect to polarity, install the wires from the other gang box to the load side of the GFCI and tighten the screws. Install a pigtail into the ground on the GFCI and tighten.

12. Align the grounds, twist, trim and install a red wire nut.

13. Using a screw driver, install the GFCI in the gang box leaving the screws 2-3 turns loose.

14. Using a flat blade screw driver, install and align the face plate on the GFCI in the gang box.

15. Using the appropriate screws (self drilling, square drive in this case), install both gang boxes in the piloted holes in the control panel.

16. Congratulations! Your control panel is now completed.

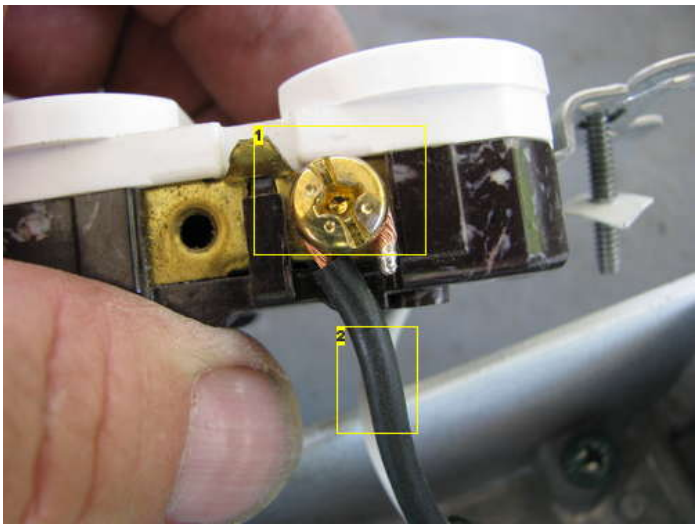


Image Notes
1. Wrap in clockwise direction.
2. Black wire to brass screw

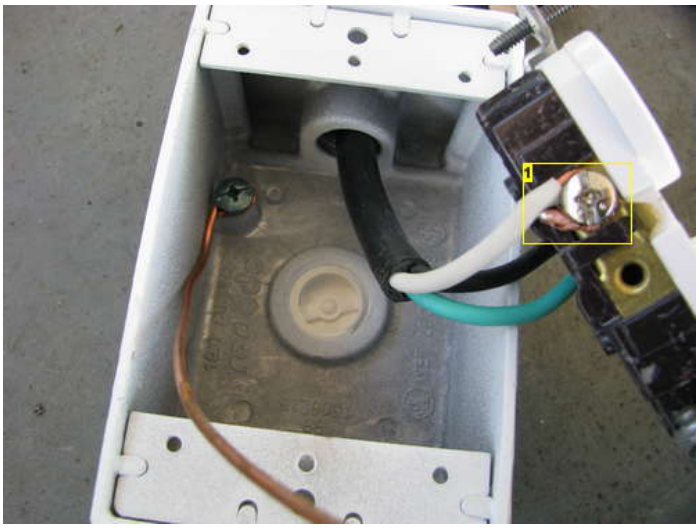


Image Notes
1. White wire to silver screw

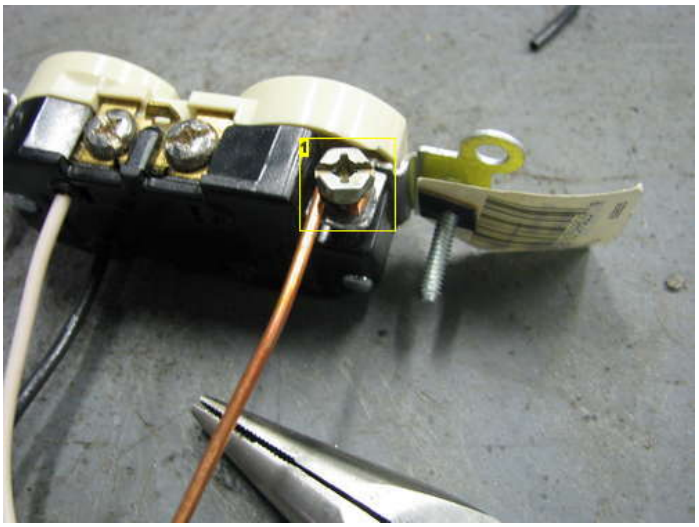


Image Notes
1. Ground pigtail in clockwise direction

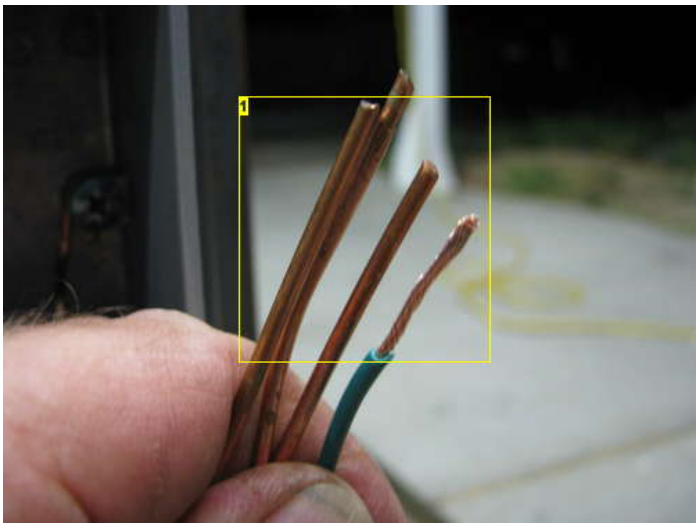


Image Notes
1. Ground wires ready to be twisted. Try to align ends.

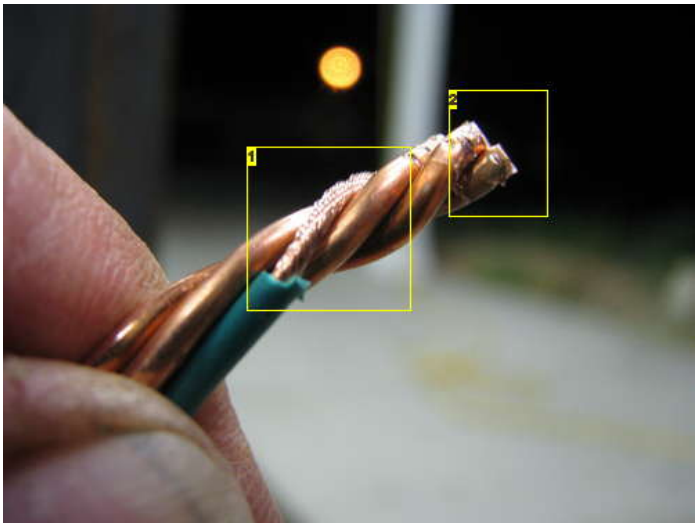


Image Notes
1. Ground wires twisted
2. I like to trim the ends to the same length. It prevents one from being too long and allowing another conductor to slip out of the wire nut.

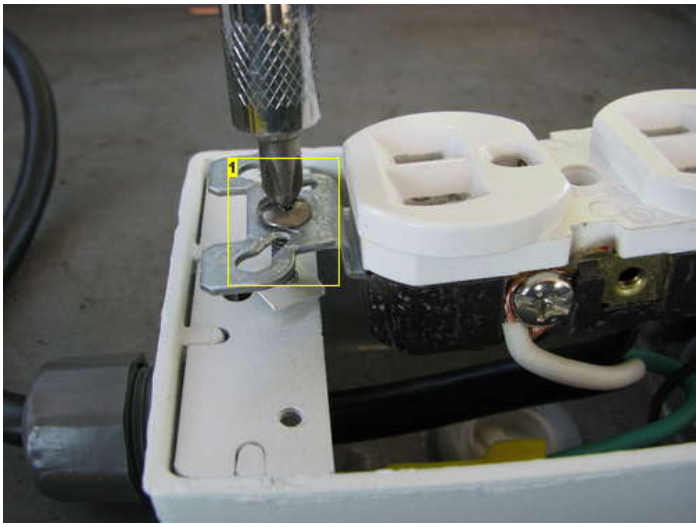


Image Notes
1. Installing device in box

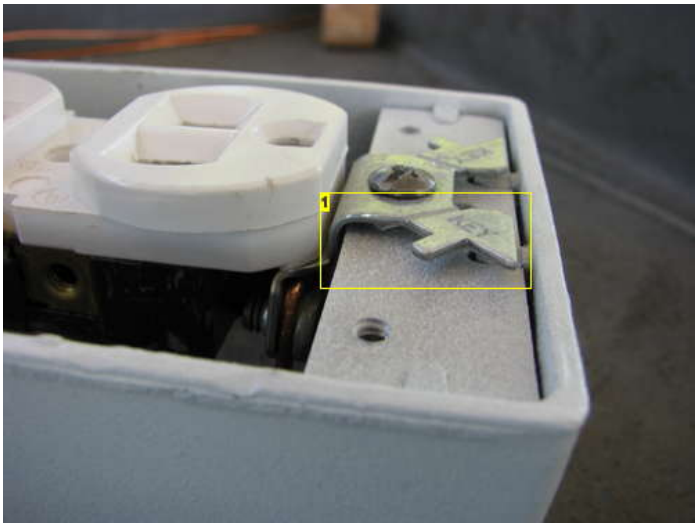


Image Notes
1. Leave the device 2-3 turns loose to allow face plate to be installed and aligned properly.

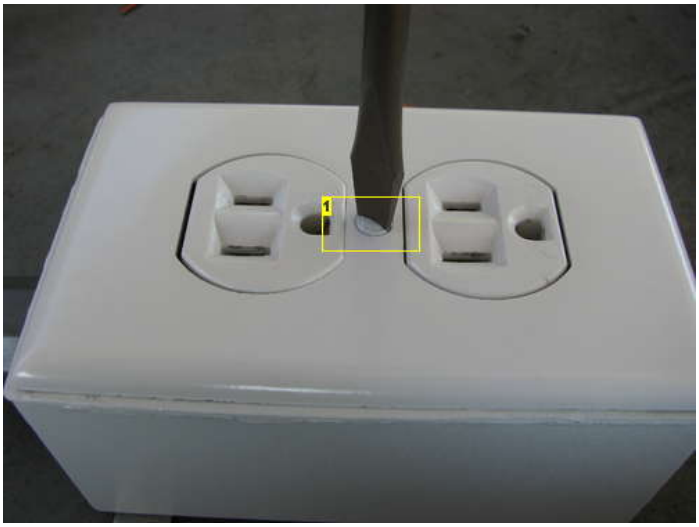


Image Notes
1. Installing face plate.

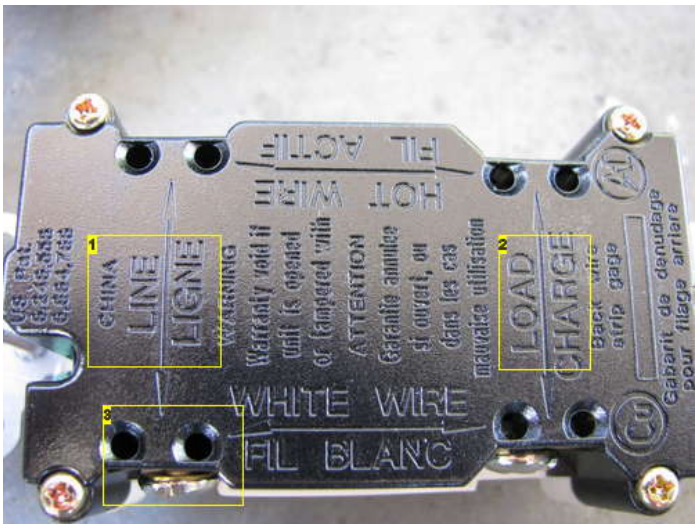


Image Notes
1. Line side is for the power in.
2. Load side is for the power out to the other recepticle
3. These are not "stab-ins". This screw should be loose when installing the wire, and tightened once the wire is in place.

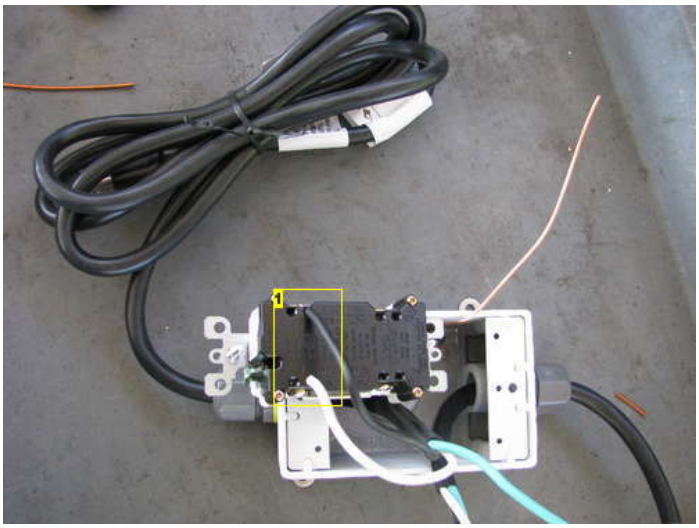
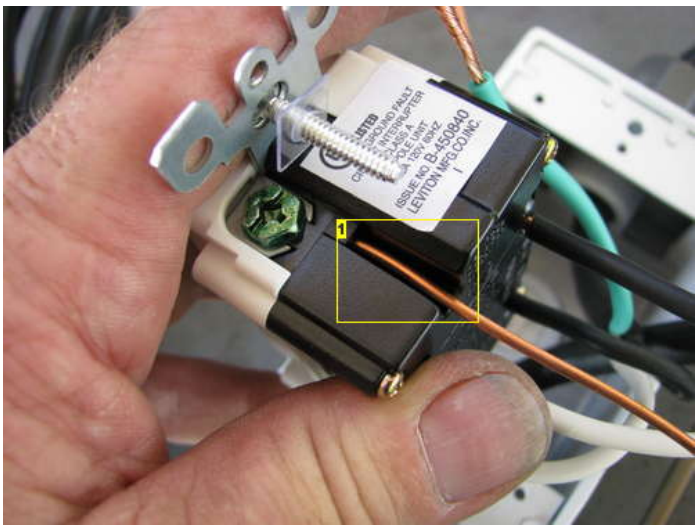


Image Notes
1. Line side



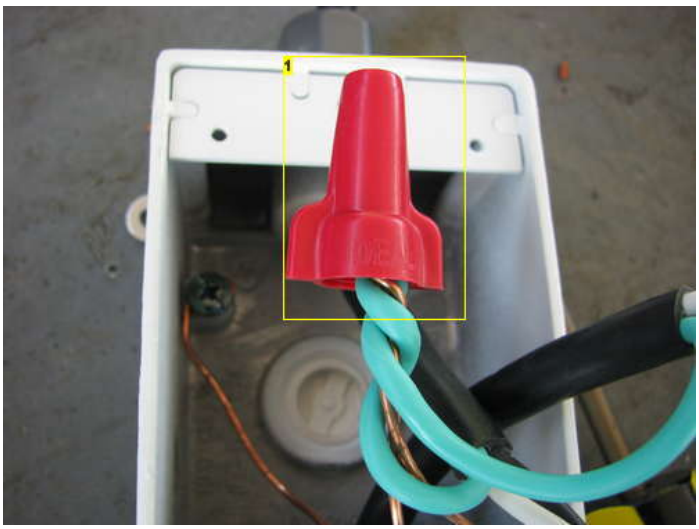


Image Notes
1. Ground Pigtail

Image Notes
1. Grounds twisted, trimmed and wire nut installed. Be sure to use the correct color/size for the gauge and number of conductors.

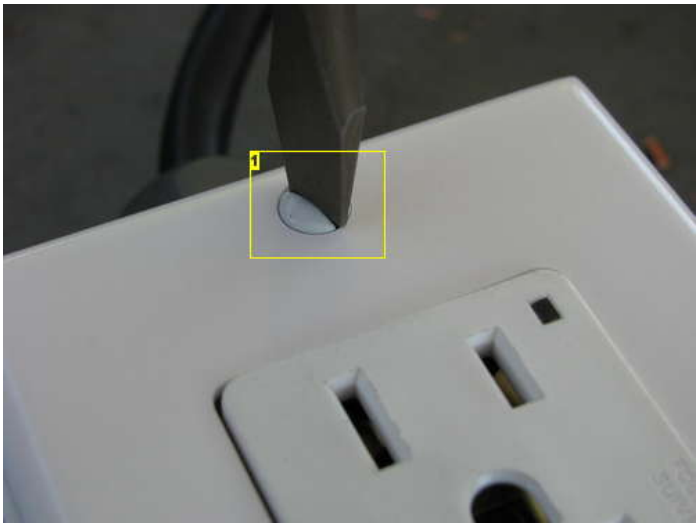


Image Notes
1. Installed and left 2-3 turns loose.

Image Notes
1. Face plate instalation.

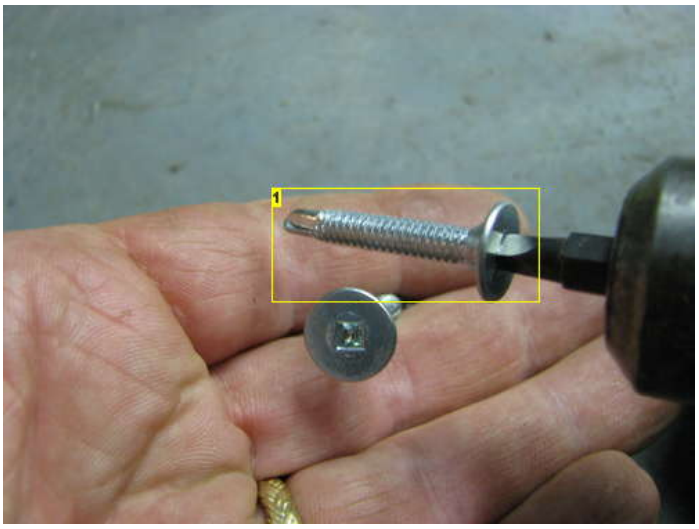


Image Notes
1. Self drilling square drive. Drill a pilot hole anyway.

Image Notes
1. Control panel wired!

step 13: Paint

Of course you have to paint it. It is predominantly steel and will be in a wet environment. I use Rust-oleum High Performance Enamel - Safety Blue. As I paint just about everything this color, my kids and my students have taken to calling it "D-Blue"

I also like using a snap on or clamp on handle.

No need for numbered steps. Mask off anything you don't want blue. Lay enough cardboard on the driveway so the direct over spray won't hit. (the indirect over spray will simply sweep up)

Flip the beastie over and start with the bottom. Flip it right side up and paint everything else!

Image Notes
1. "D" Blue

Image Notes
1. Rattle can handle

Image Notes
1. Paint bottom first

Image Notes
1. Yup, old control panel.

Image Notes
1. Looks good!

step 14: Nutrient Delivery System - The pump(s)

The nutrient delivery system starts with a tank (plastic container) and uses a pump (Harbor Freight cheepie) to send the nutrient fluid through tubes (1/4" Poly tubing for drip irrigation) up to the Plant troughs (Plastic rain gutters). The nutrient solution then returns to the tank (Evaporative (swamp) cooler drain and PVC pipe) via gravity.

If you are not building the experimental model, you will only need the first part of this step. If you are building the experimental version, you will need the second pump and tank.

1. These are the pumps and the adapters with which they come.

2. 1/2" hose barb to 1/2" MPT and the quad manifold.

3. Three wraps of Teflon tape on the male threads and thread in the hose barb..

4. Cut a piece of 1/2" tubing long enough to go over the barb and the pump adapter.

5. Pump, adapter, tubing and barbed manifold.

6. Assembled assembly.

7. Cut the 1/4" Poly tubing long enough to go from the middle of the tank to the supply end of the troughs. I left about a foot of extra length just in case. They came out to 60".

8. Force one end of each 1/4" poly line on the outputs of the manifold.

9. Use two for the experimental model and all four for the home use version.

10. Place the pump assembly in the tank. We will add to this later.

11. Force the output ends of the supply lines through the grommets in the troughs.

If you are not building the experimental model you can go onto the next step.

For the experimental model we wanted to be able to supply one trough with plain water and another will receive no fluid. A second pump is used with a single Poly line to supply the plain water

You can simply duplicate the manifold for the second tank or just use the 1/4" adapter and a single Poly line on the second pump.

12. Heat a small amount of water in a microwave safe dish in the microwave, turn off the microwave and submerse the end of the Poly line in the hot water.

13. Force the end of the Poly line through the adapter until about 1/8" is sticking through. Make sure you have adequate children's pottery on the top of the stove.

14. Using the propane torch, heat up the tapered punch (2 seconds max!) and use it to swage out the end of the Poly line in the adapter.

15. Swaged Poly line in adapter.

Image Notes
1. Cheep Harbor Freight pumps.
2. Each pump came with a 1/2" and 1/4" adapter.

Image Notes
1. 1/2" hose barb

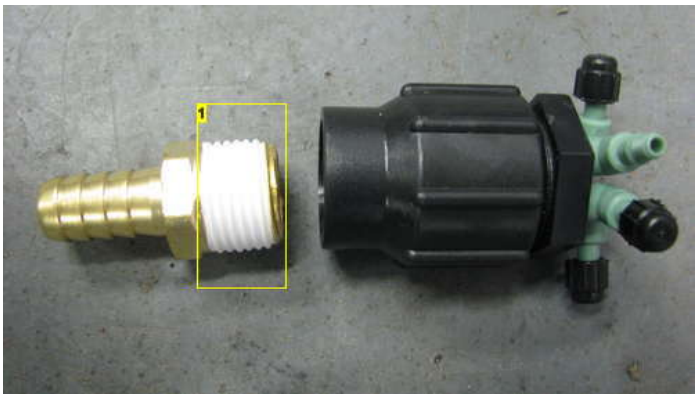


Image Notes
1. 3 wraps of teflon tape

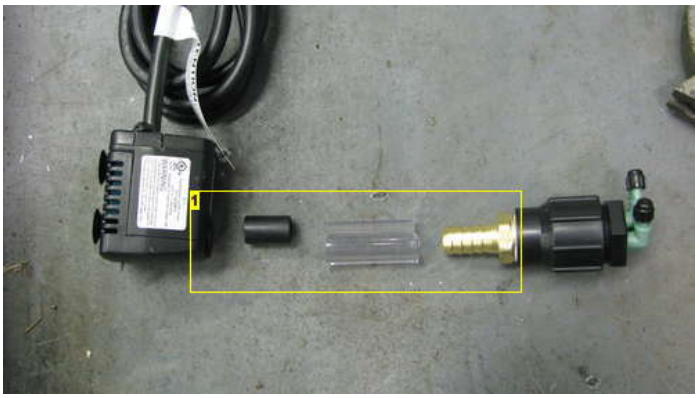


Image Notes
1. Ready to be assembled

Image Notes
1. Low pressure application. No hose clamps needed.

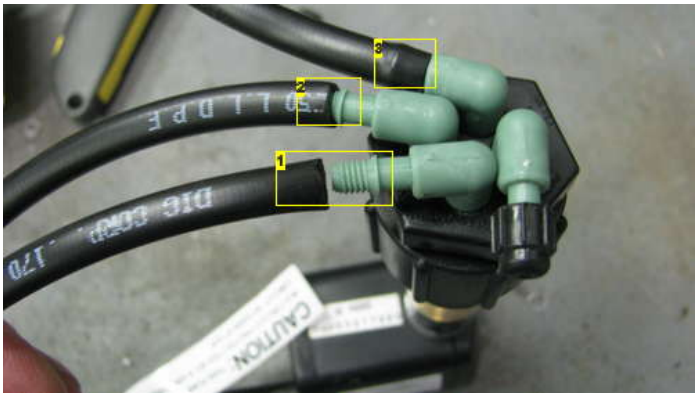


Image Notes
1. Ready
2. Set
3. Done!

Image Notes
1. We only need two for this applicaton. Save the extra cap anyway.

Image Notes
1. Test fit looks good
2. Drain pipes above the tank.

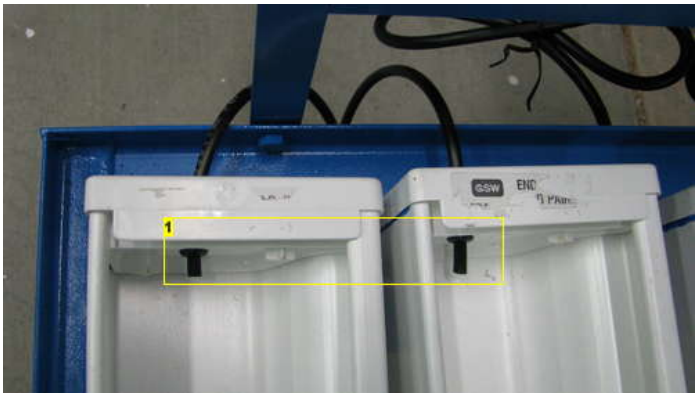


Image Notes
1. Supply lines through the grommets.

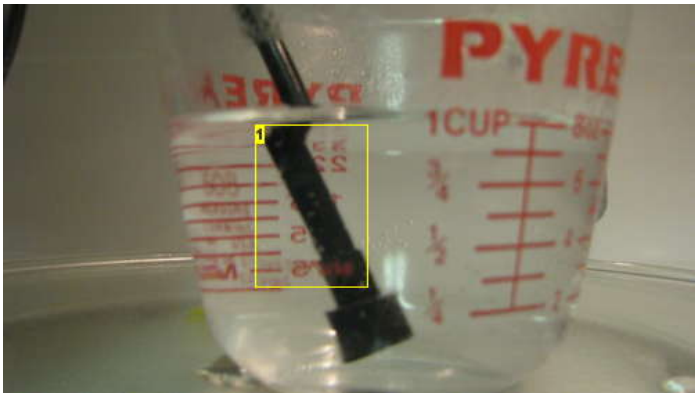


Image Notes
1. Heating the poly tube in the microwave. It took to heating and pushing cycles to get the tube all the way through the adapter.

Image Notes
1. About 1/8" past the step in the adapter.

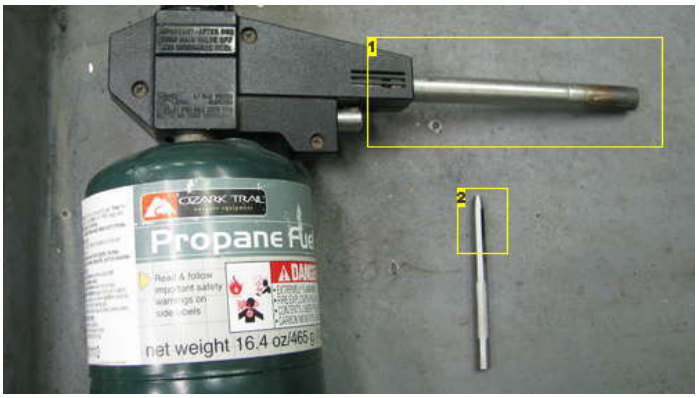


Image Notes
1. This was this torches last job. It fell off of my cart and broke. Lucky for me the flame tube broke and not the propane fitting!
2. Tapered punch for swaging the inside of the poly tube.

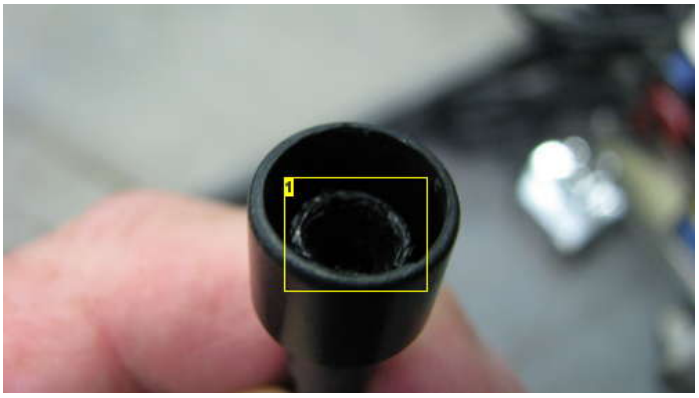


Image Notes
1. Expanded (swaged) poly tube in the adapter.

step 15: Trough defect fixed - The bow removed

The rain gutters are designed to be attached to a house with brackets that keep the tops opened. Without the brackets the tops of the rain gutters bow inward quite a bit. unfortunately, I didn't realize this until after the end caps were glued on.

Ahhh well. Here is how I installed the brackets on the two troughs that needed them. I did buy 4 brackets just in case the other two felt inclined to bow inwards in the future.

1. These are the brackets I bought after the fact.

2. Mark the middles of the troughs that need the brackets

3. Angle the bracket up under the outer lip and lever it in place.

4. Outside of bracket in place

5. Long view of outside of bracket in place.

6. Get your trusty assistant to assist you while you pull the inside edge of the rain gutter up and have your assistant force the bracket down over the lifted lip of the gutter.

7. Use a flat blade screw driver to force the inside edge of the bracket up against the lip of the rain gutter.

8. Use a flat blade screw driver to curl the upper lip of the rain gutter in place over the edge of the bracket.

9. Viola! the bracket is installed!

Repeat as necessary and then go nurse your torn up thumbs from trying to deform the silly lip of the rain gutter.

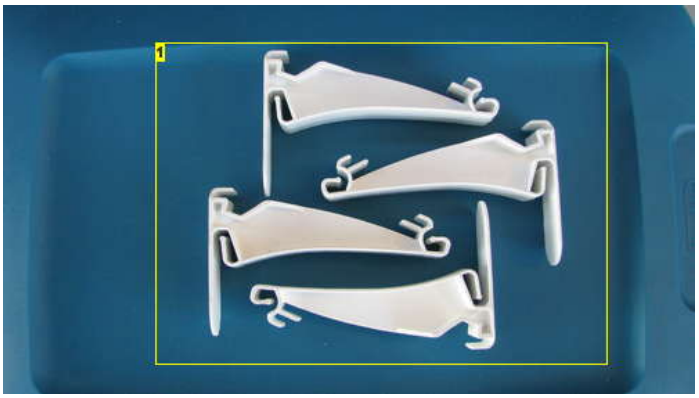


Image Notes
1. Rain gutter hanger brackets. Used to space open the tops of the troughs.

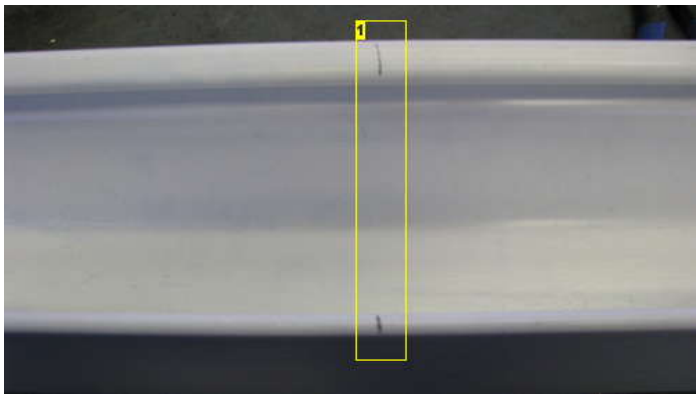


Image Notes
1. Center marked.

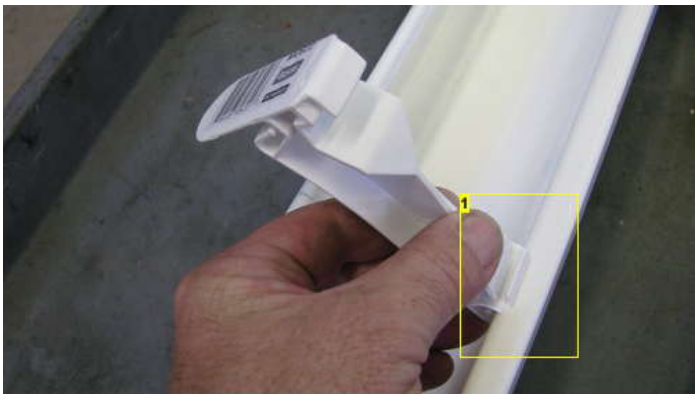


Image Notes
1. Angle bracket up and force under outside edge.

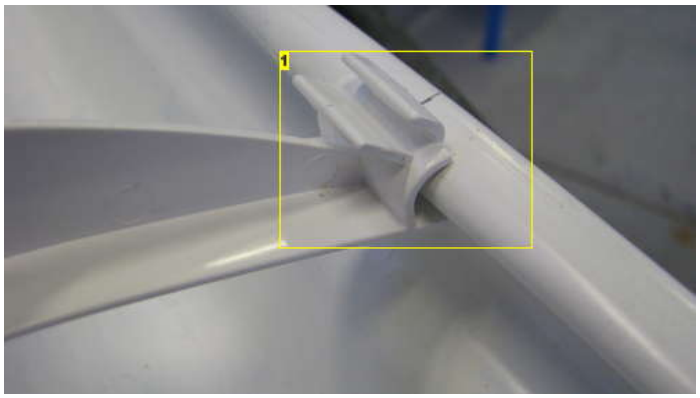


Image Notes
1. Outside edge in place

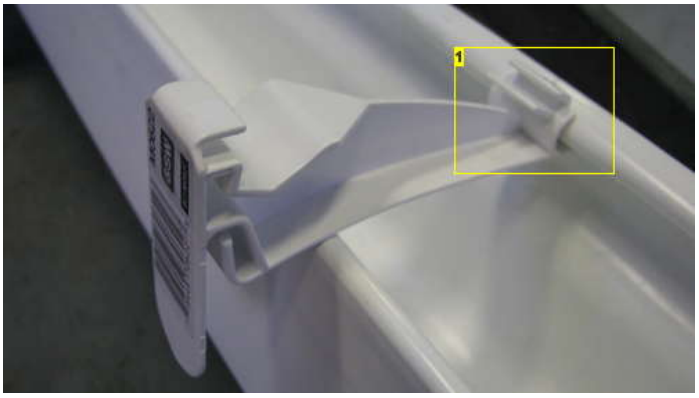


Image Notes
1. Outside edge in place - long view.

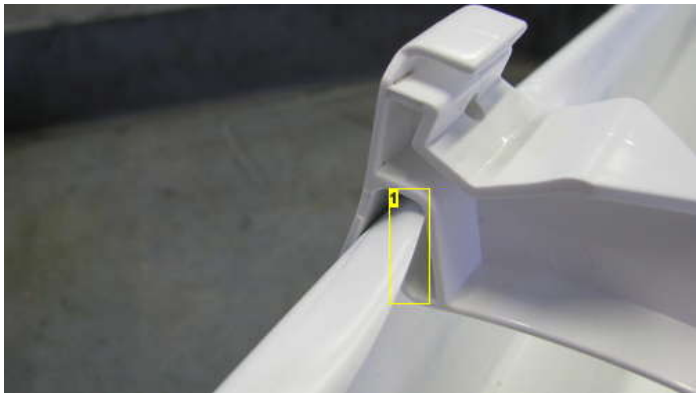


Image Notes
1. Force edge up and push bracket down.

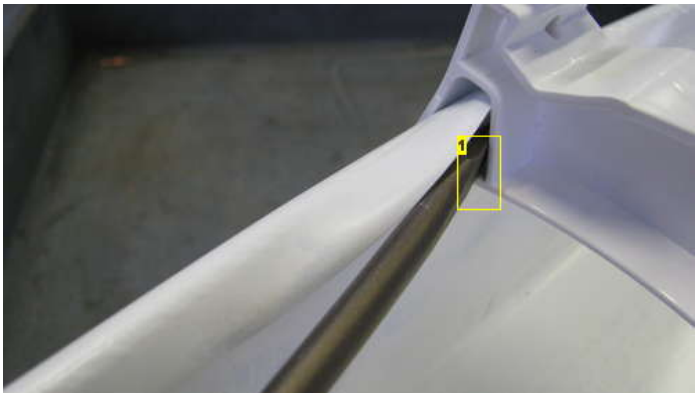


Image Notes
1. Force bracket back against lifted edge.

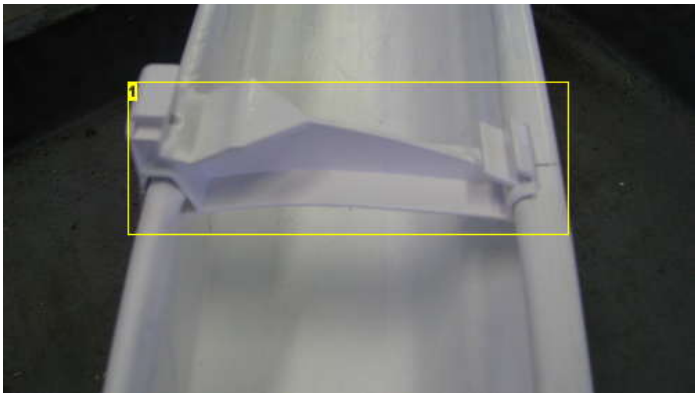


Image Notes
1. This would have been much easier if I had installed them before gluing the end caps on!

step 16: Aeration

I am given to understand that by oxygenating the nutrient solution, the plant's roots will absorb O2 and thereby cause flourishing to commence

We used a simple aquarium air pump and hardware to accomplish this task.

1. Aquarium pump, tubing, fittings, air stones and electronic timers.

2. Using cable ties, secure the air pump to the control panel.

3. For the experimental model, fit a "t" inline with the pump and run tubing to each tank. Not shown is a control valve fit inline with the second tank. As the tanks will have unequal quantities of fluid (due to evaporation and absorption) a valve was needed to balance the air supply.

Obviously for a single tank a single line is all that is needed.

4. Fit an air stone on the tank end of the air line and cable tie it to the pump line. I kept the air stone a few inches away from the pump so as not to intake any air.

5. Go buck wild with the cable ties to manage you hoses and lines.

Image Notes
1. Replacement timers for the one that kept tripping the GFCI outlet.
2. Aquarium stuff

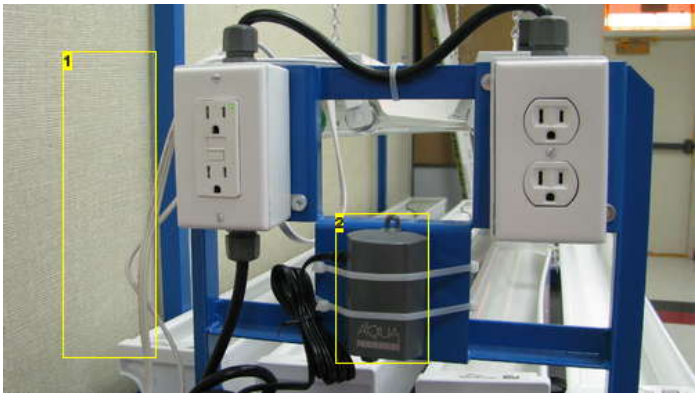


Image Notes
1. Final version of control panel
2. Aquarium air pump and cable ties

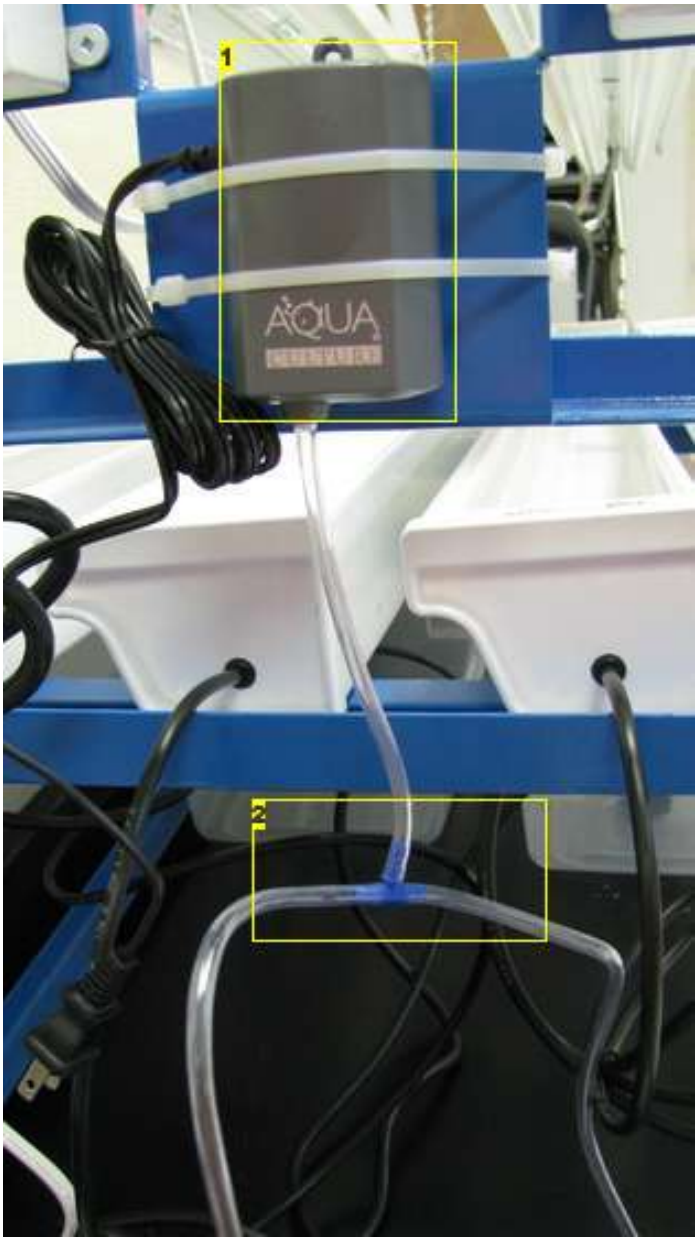


Image Notes
1. Air pump installed.
2. This "T" is only necessary if you are running two tanks.

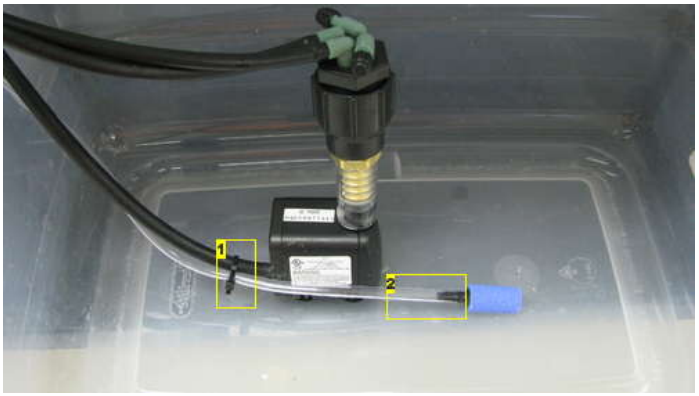


Image Notes
1. Cable tie to keep air stone in place under nutrient solution.
2. A bit of space to keep pump from drawing any air bubbles into itself.

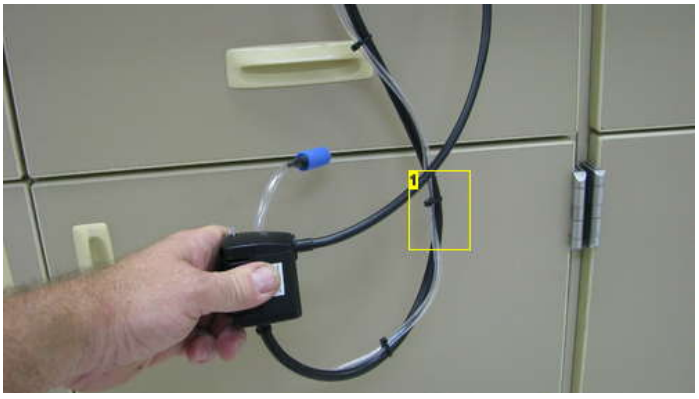


Image Notes
1. Cable ties to keep wires and lines in place.

step 17: Set-up!

Assuming you have built this at home and dis-assembled it to transport it to school, here is how to set it up. In actuality, if you have built this on your own, you have no need to read through this, but I could not resist taking pictures as we set it up. Once again, please excuse the lack of chronology in the pictures.

Thanks for reading and sticking with me through this. Please provide any constructive helps or tips in the comments section. Happy growing!

Mikey

1. Set the frame on the counter to make sure it fits. (Boy, at this point it had better fit!)

2. Flip it around so yo have access to the back. (She is pretty happy it fits!)

3. Fit the light supports to the upper and lower rails.

4. Install the bolt and nut and...

5. tighten with a pair of wrenches.

6. Stand back and admire your work!

7. In order to provide the plants the optimum light we lengthened the chain and added a second "S" hook at the top.

8. This allows the chain to be looped up to allow for close light for the small plants and to raise the lights as the plants grow.

9. It will also allow for different experimental conditions if needed.

10. Carefully set one end of the light fixture on the frame and attach the hook to the other.

11. Lift the second end in position and attach the second hook.

12. Assuming you haven't already, install the fluorescent tubes in the fixtures.

13. Bolt on the control panel.

14. Climb on top of the desks the custodial staff have stacked against your cupboards to locate a measuring spoon to measure your nutrient concentrate.

15. Vigorously shake your nutrient concentrate.

16. Measure the required amount into a secondary container to premix with water. (This stuff is like tar.)

17. Pour the premixed concentrate into your tank.

18. Top off with water to reach the required concentration.

Note: this is way too much solution in the tank. We figured that the container said 12 quarts so 2 gallons should be sufficient. You are looking at 2 gallons in a supposed 3 gallon container. I think the manufacturer fibbed about the capacity. We removed a gallon of solution and it looked perfect.

19. Take the seedlings (planted rock-wool) that you have been germinating for the last week from their container and...

20. Place them in their new nutrient rich, oxygenated, light intense home!

We are still trying to decide on an inexpensive root support matrix (a slotted pot with Perlite and coconut husks) that we can use with the students. The Perlite and coconut husks are not too bad cost wise, but the slotted pots are .25 each. While that doesn't sound like too much, my wife will have 150 students to supply. We have already tried styrene cups and expanded polystyrene (Styrofoam) cups but the nutrients will not reach high enough (without adding a wick) to be wicked in. Your suggestions are appreciated!

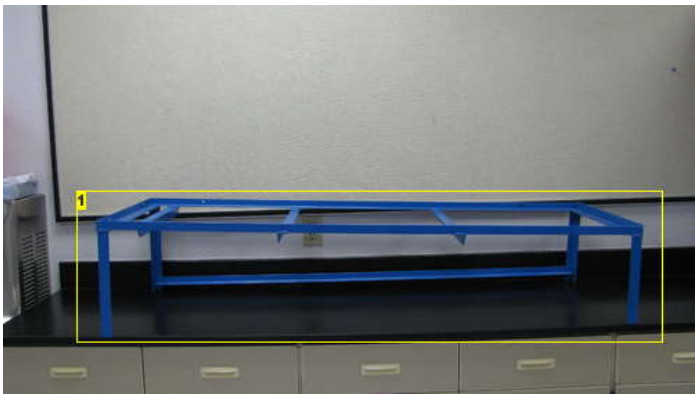


Image Notes
1. Checking to make sure I measured correctly.

Image Notes
1. Frame backwards to ease installation of light brackets.
2. Happy science teacher!

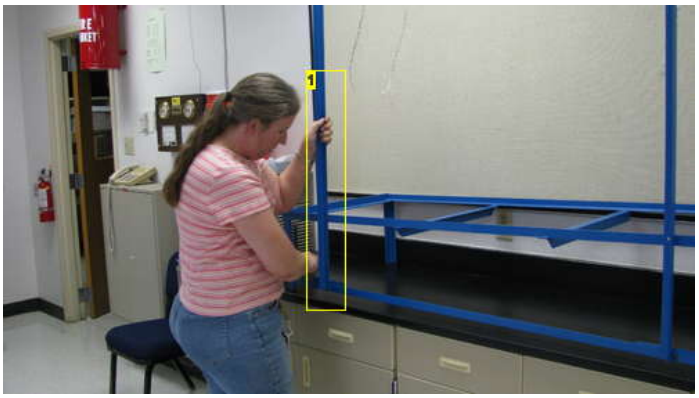


Image Notes
1. Installing the light brackets.

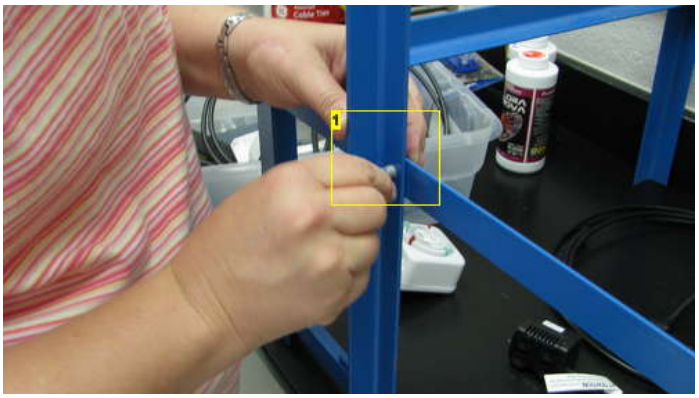


Image Notes
1. Bolting in place

Image Notes
1. Tightening with two wrenches.

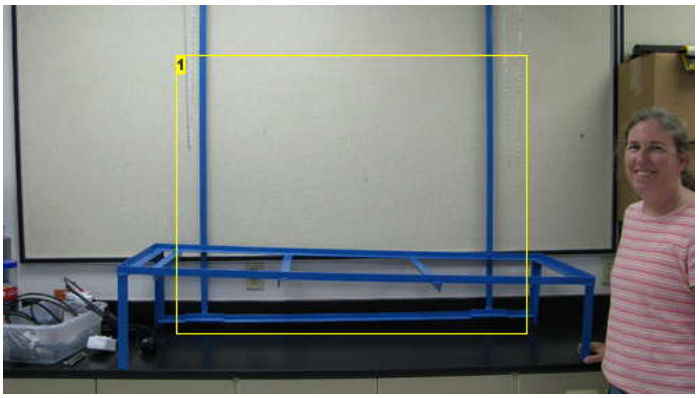


Image Notes
1. Ta Da! Light brackets intalled!

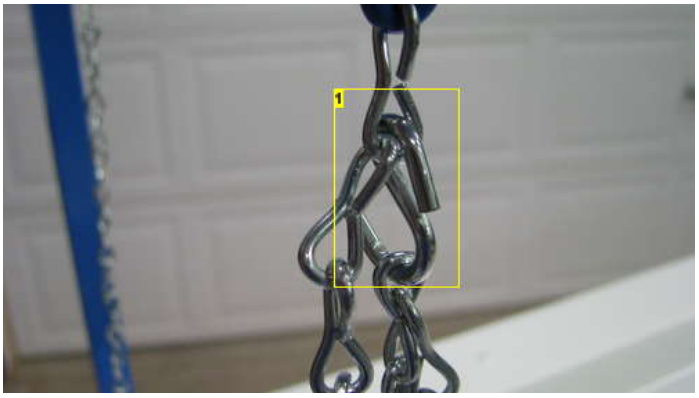


Image Notes
1. Second "S" hook on the top of teh chain to form height adjuster loops.

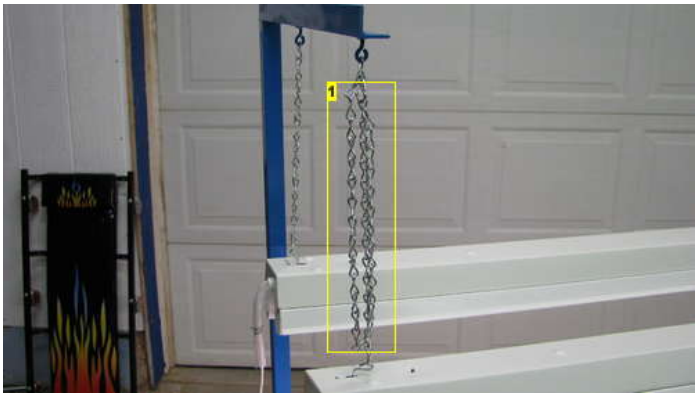


Image Notes
1. Height adjuster loop.

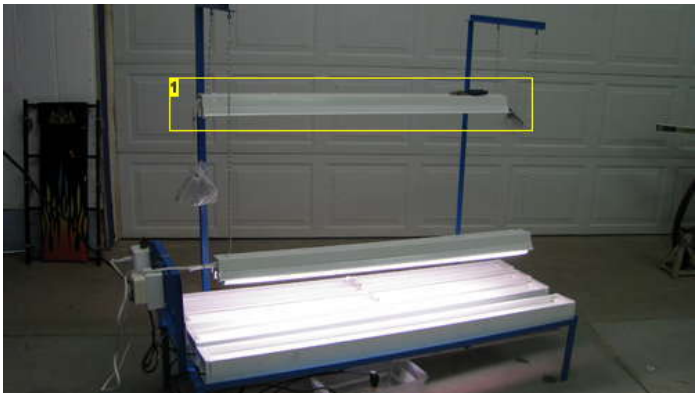


Image Notes
1. Adjuster loop test.

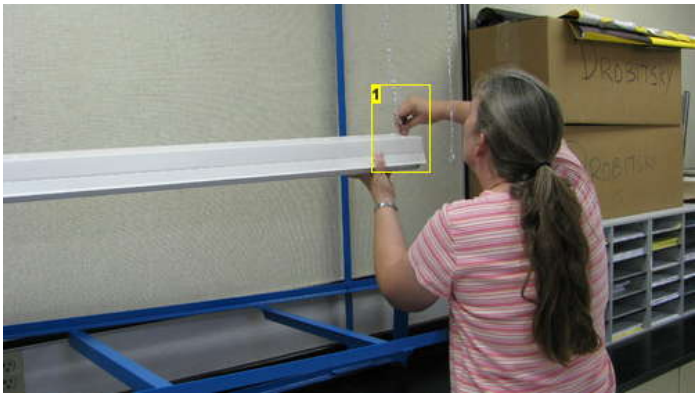


Image Notes
1. Then hook the other.

Image Notes
1. Control panel bolted in place.

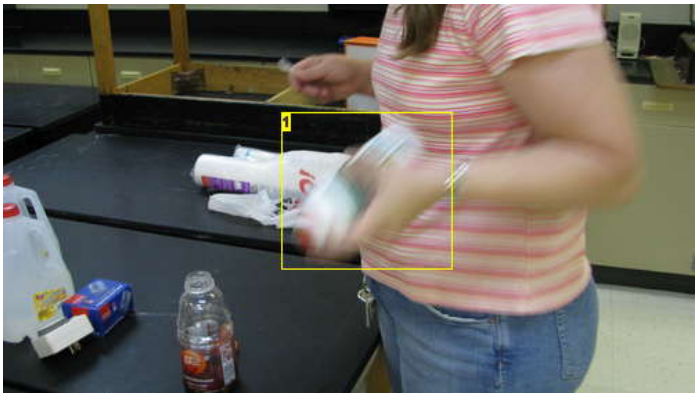


Image Notes
1. Oooo an action shot! Vigerously shake the nutrient concentrate.

Image Notes
1. Hook one end

Image Notes
1. Hmmm. Is this a defect in my plant light

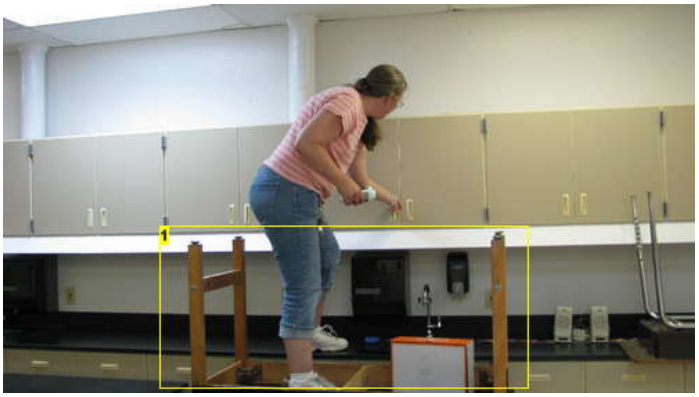


Image Notes
1. Trying to locate a measuring utensil

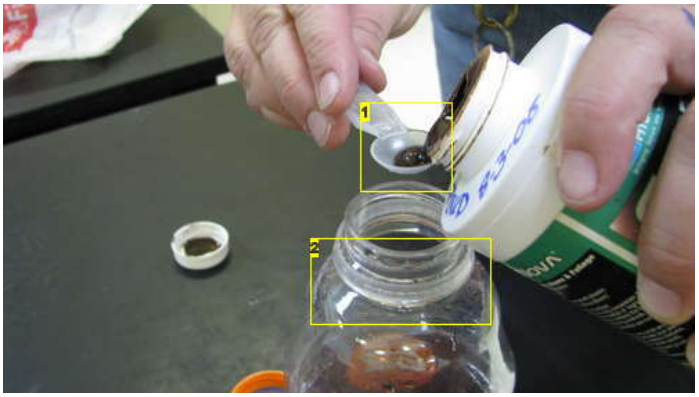


Image Notes
1. Preciaion measurement of tar like gloop.
2. We made sure it dispersed in water before adding it to the tank.

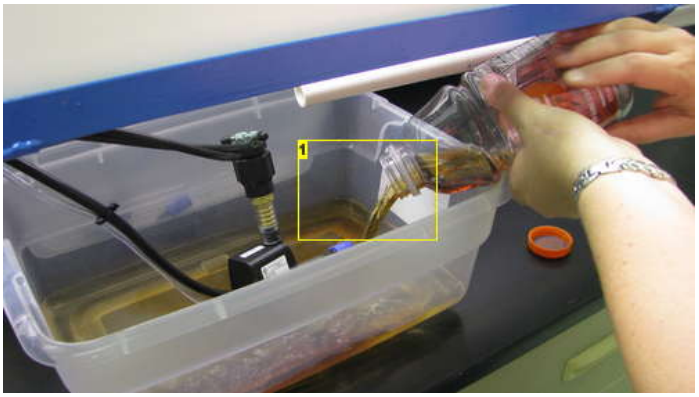


Image Notes
1. Tank meet nutrient solution, nutrient solution meet tank.

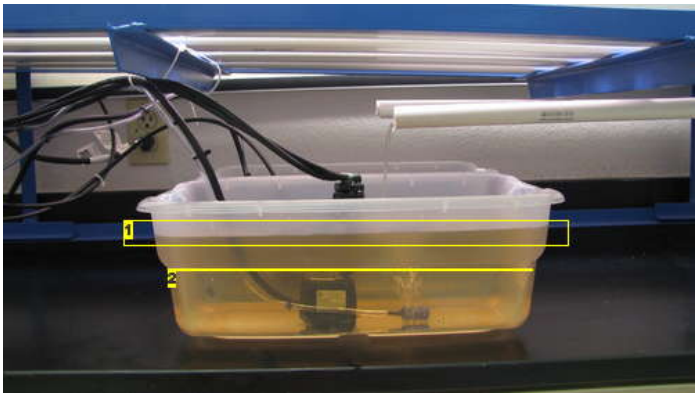


Image Notes
1. Way too full!
2. We removed about one gallon so the level was down to here.

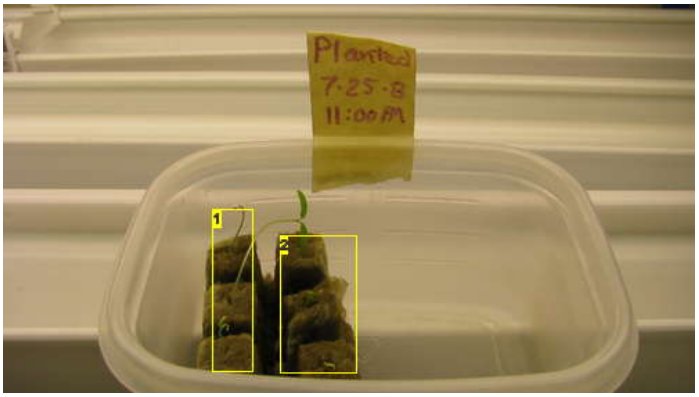


Image Notes
1. Tomatoes
2. Jalapeno peppers

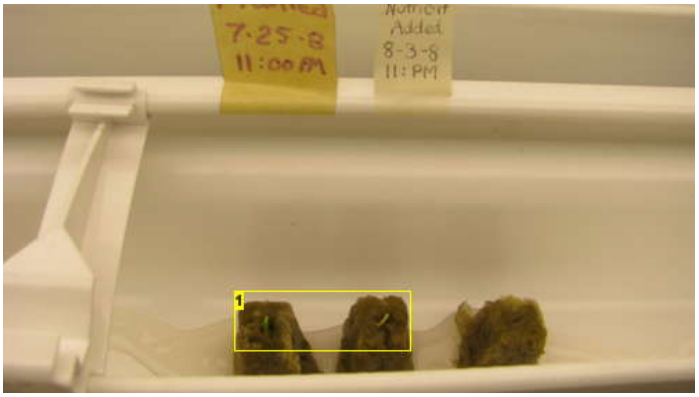


Image Notes
1. Their new home!

Related Instructables

Understanding Hydroponics by dutchypoodle

My Indoor DWC Hydroponics System by LancePenney

Almost Free - DIY Simple Hydroponics by Mr E Man

Hydroponics grow kits - Grow it by hydroponicsgrowsh

Even Simpler Flood and Drain System - The Mosquito by wiley coyote

Colander hydroponics by chefmichel

Hydroponic float system by Tool Using Animal

Propagation in Rockwool cube by hydroponicsgrowsh

Comments

47 comments Add Comment

Dino1981 says: Nov 15, 2008. 6:49 AM **REPLY**

Nice work 1st place.....

Mikey D says: Nov 16, 2008. 8:44 AM **REPLY**

Thanks Dino!

Saga says: Aug 7, 2008. 7:34 PM **REPLY**

Do a search for Rapid Rooters. They are about 1"x1"x3", around $0.26/ea. and will be great for NFT. They are an organic growth medium made of composted organic materials.

Since you plan on putting a cap over the gutters, if you choose to use the Rapid Rooters you can use a hole saw to cut holes in the cap slightly smaller in diameter than the RRs and squeeze them into the holes letting the bottoms of the RRs touch the bottom and wick the nutrients("nutes"). If necessary, you can slide a toothpick through them perpendicularly to prevent them from dropping into the hole.

I also suggest that you obtain a completely opaque Rubbermaid-type container for your reservoir. This will help combat algae growth. I have seen black ones at Wal-Mart and Target in the auto parts section. If you already have algae in the system you can remove it with a brush, or use hydrogen peroxide (3ml of 3% H2O2 per gallon of solution) to remove it.

Best of luck!

Mikey D says: Aug 7, 2008. 9:58 PM **REPLY**

Thanks Saga!

We also found slotted pots for around the same price but are already far over budget. We need to be able to provide for about 150 units and this is coming out of pocket.

Excellent catch on the opaque reservoir. Your idea reminded me that that is what I used quite a few years ago. I had also tried a UV light in one instance (with a dark control tank for comparison)to kill the algae, but it just made it grow quite a bit more prolifically! :-)

Conceringin the H202, would you add it to the nutrient solution or just as a cleaner when changing solutions?

Thanks again!

Mikey

Saga says: Aug 8, 2008. 8:36 AM **REPLY**

You can add the H2O2 directly to the nutes.

Another element that mustn't be overlooked is the temperature of the nutrient solution itself. Even a difference of 5 degrees can have a dramatic effect on the growth rate. The ideal temperature is 70 degrees. A self-regulating, submersible aquarium heater can make all the difference in air conditioned classroom.

I truly appreciate the out-of-pocket investment you are making in the student's lives. Hydroponics is a fantastic way to get kids engaged in a process that stimulates the mind on many levels. Huzzah!

Mikey D says: Aug 8, 2008. 6:16 PM **REPLY**

I guess I need some clarification...

Are you referring to keep the nutes as warm as 70 or as cool as 70. We are in Arizona and odds are the classroom is going to be warmer than 70 degrees.

I have heard that cooling the nutes is better because the solution will hold more O2 as it gets cooler. Are you saying we should keep it above 70 degrees?

Thanks!

Mikey

Saga says: Aug 8, 2008. 7:25 PM **REPLY**

70 is ideal. The cooler the temperature, the more the plants will edge toward a dormant state. The warmer the temps, the greater the risk of root rot or shock. Aquarium heaters are cheap. Aquarium chillers are generally more expensive.

I have seen people pump nutes through the front door of a re purposed mini fridge into the freezer portion where it then ran through a coil of tubing that was placed in an aluminum meatloaf baking tin that was filled with solid ice, then back into the reservoir. While it would be much more efficient to use a copper coil instead(i.e.; for a wort chiller), any metal will react with the salts in the nutrient solution and dramatically alter the pH balance(which reminds me; your seedlings will probably do best slightly acidic, with a pH of 6, depending on what you are growing. Bump it up to pH neutral once they are established). Another low-cost method is to blow cool air over the nutrients, but however it is achieved, remember to avoid letting excessive light into the reservoir.

Cheers!

Mikey D says: Aug 9, 2008. 10:22 AM **REPLY**

Sounds good.

When we work up the lab sheet for the students we will include temperature and PH.

Do you have a low cost Ph modifier that will not adversely affect the nutrient solution?

Thanks for the excellent information!

Mikey

dutchypoodle says: Sep 11, 2008. 4:33 PM **REPLY**

Depends on what your PH is currently. I don't reccomend using activated charcoal, for sure.
Turn your eyes to the aquarium section of your local pet store, and talk to a knowledgable employee. They'll be able to steer you in the right direction.

DavidMF says: Aug 7, 2008. 6:27 AM **REPLY**

As the plants in the troughs grow wont you need some kind of bracket to keep the plant from slidind down the trough and so not to smother the roots? Great instructable!

Mikey D says: Aug 7, 2008. 8:34 AM **REPLY**

We figure that for the experiments in the classroom, 3/4 of the plants will die. We will then redistribute the living ones (the control group) amongst the troughs. We plan on using some string from the light brackets for the plant support structure. We'll also add some white covers with holes for the stems to keep light off of the roots.

Thanks David

Tool Using Animal says: Aug 7, 2008. 10:25 AM **REPLY**

Just get some rockwool cubes.

Nicely done!

Mikey D says: Aug 7, 2008. 9:53 PM **REPLY**

Thanks TUA.

We did start the seedlings in rockwool but are concerned that it will not provide enough stability as the plants mature.

Thanks again,

Mikey

bob.smitty says: Aug 12, 2008. 8:14 AM **REPLY**

It seems more reasonable and practical to have some sort of small container filled with rockwool (or other similarly inert material) to hold the plant. I don't see how they will be held in place in the through without something like this; the roots still need to hold on to something, or you have to have something to hold the plant from the stem. Any holey container would do, i guess, but i'm thinking the little baskes that you buy cherry tomatoes in would be particularly well suited.

and, btw, great instructable and great execution. solid.

Mikey D says: Aug 12, 2008. 10:25 AM **REPLY**

Agreed!

We plan on putting the rockwool into a container. We just need one with a low enough lip on the bottom for the nutrients to reach the roots.

Thanks!

Mikey

nafango22 says: Aug 11, 2008. 12:32 AM **REPLY**

science class.

yea, im sure.

bob.smitty says: Aug 12, 2008. 8:04 AM **REPLY**

yah... damn hippies! :)

thermoelectric says: Aug 10, 2008. 12:36 AM **REPLY**

This is soo cool,
I would make it but i think it's a tad too big
5 stars

Mikey D says: Aug 10, 2008. 9:49 AM **REPLY**

Definitely way too big for the living room! :-)

However it can be scaled way down, I'd only use 2 troughs and put some space between them.

In the not to distant future I am going to build one for the living room with a 2-1/4 sq ft footprint.

Thanks for the stars!

Mikey

thermoelectric says: Aug 10, 2008. 9:58 PM **REPLY**

Cheers

Thermoelectric

bairdwallace says: Aug 10, 2008. 10:44 AM **REPLY**

Great instructable! Very comprehensive! What was the total cost, and number of hours?

Mikey D says: Aug 10, 2008. 3:22 PM **REPLY**

The total cost with the nutrients and rockwool was around $240.

Total number of hours (this is a SWAG) is currently around 15 hours.

Thanks!

Mikey

BlueWeasel says: Aug 8, 2008. 9:12 PM **REPLY**

We use to make slotted cups by taking small plastic Solo drinking cups and putting holes in them with a wood burning tool.

I'm hoping to rebuild/resetup my rig again soon.

We were harvesting roma tomatoes faster than we could eat them.
I picked over 100 habanero peppers in one harvest.

I made half a gallon of pesto off of one basil plant.

The nutrient formula can be a hassle to balance (I don't have a copy of what we were using anymore).

South Texas heat and an outdoor setup makes for careful management of water levels between evaporation and tomatoes being VERY thirsty.

Mikey D says: Aug 8, 2008. 9:42 PM **REPLY**

Excellent Blue!

I tried the slotted cup idea but the nutrents didn't come up into the holes. Maybe if we had some wicking media (coconut husks for example) protruding slightly it would work better.

We want to use one at home but I have already shaded all of the southern exposure windows with exterior awnings. I'm thinking of building a semi-decorative one for the living room.

Thanks for the input.

Mikey

BlueWeasel says: Aug 8, 2008. 11:22 PM **REPLY**

You may need a higher rate of nutrient flow. We didn't have any medium in there to wick up.

We spread the roots flat in the cups and holes in the bottom plus slots that went all the way down to the base let enough water in.

Sometimes clay potting balls were used to hold plants up or a piece of plastic foam (like are used in pool 'noodles' would be used to center plants in the cups.

Mikey D says: Aug 9, 2008. 9:50 AM **REPLY**

The volume of the nutrient flow is something I had considered. It would of course mean replacin the 1/4 poly (1/4" OD) with some larger tubing.

We are germinating in rockwool which makes an excellent wick. We were hoping to use the rockwool in a cup with support medium. I was thinking of Xboogerx suggestion of gravel. I just need slots wide enough and teh rockwool deep enough (defianately touching the bottom of the trough) to allow the solution to get to the rockwool base.

Thanks for the spot on hints!

Mikey

mamasansioux says: Aug 8, 2008. 7:58 PM **REPLY**

Good job, Mikey. I hope the school system in your home town (city?) appreciates your extra curricular effort and talent. Today's children need more like you.

Mikey D says: Aug 8, 2008. 8:23 PM **REPLY**

Thank you MamaSan.

Sometimes it is difficult to determine whether or not the district appreciates us. We are however teachers for the children, not the silly beauacratic adults. ;-)

Thank you for the kind words.

Mikey

Grey_Wolfe says: Aug 8, 2008. 12:23 AM **REPLY**

Awesome use of design to accomodate class space requirements, Mikey.

Excellent project, and I hope it gets more attention from the educators around the net.

Mikey D says: Aug 8, 2008. 7:25 AM **REPLY**

Thank you kindly Grey!

Mikey

tre battle says: Aug 7, 2008. 4:14 PM **REPLY**

lol I feel ya good help lol but sadly those 8th graders wont be using this to grow roses when they are freshmen in high school

Grey_Wolfe says: Aug 8, 2008. 12:20 AM **REPLY**

We built an entire hydroponic green house (30ftx50ft) my freshman year, and we weren't all out to grow anything inappropriate.

There were a few attempts in subsequent years to try to introduce new 'crops' as it were, but it's kinda hard to hide something like that among tomatoes and zucchini.

Mikey D says: Aug 7, 2008. 10:06 PM **REPLY**

I guess this single reply will address all Y'all. Thanks for the props but we will NOT be growing herbs.

Have a clean one!

Mikey

digitalenigma says: Aug 7, 2008. 7:14 PM **REPLY**

Man i could have saved a boatload of money in the 8th grade if i had access to this instructable then!

LancePenney says: Aug 7, 2008. 2:36 PM **REPLY**
Wow this is crazy! Great job!

Mikey D says: Aug 7, 2008. 10:05 PM **REPLY**
Thank you Lance.

xboogerx says: Aug 7, 2008. 11:33 AM **REPLY**
you might also want to try just your normal everyday gravel. it's cheap and would hold plants in there place. Or, you could use some other kind of small river rock.

Mikey D says: Aug 7, 2008. 10:04 PM **REPLY**
Gravel is a good idea. One of the difficulties we are having is a container that when punctured will allow the nutrient solution to be wicked up to the roots. Once the plant is mature enough, the roots will grow through the container and this will no longer be an issue.

Thanks for the idea!

Mikey

rkhound says: Aug 7, 2008. 8:42 PM **REPLY**
great idea good luck with the produce!!

Mikey D says: Aug 7, 2008. 10:02 PM **REPLY**
Thanks Mr. Hound!

tre battle says: Aug 7, 2008. 4:19 PM **REPLY**
yea i think ill be making one of these bad boys just a little bit smaller so to avoid parents

andyhuntdesigns says: Aug 7, 2008. 2:58 PM **REPLY**
Nice, just in time for Pineapple Express! ;-}

bumpus says: Aug 7, 2008. 7:43 AM **REPLY**
I love Hydroponics!
There is two year-long classes on this at my school, I wish I could take them, but I have to get my Drafting and Design in...
Excellent instructable! Great photos, well-thought out description as well!
5 Stars

Mikey D says: Aug 7, 2008. 8:35 AM **REPLY**
Me too.

Thanks Bump!

bumpus says: Aug 7, 2008. 9:22 AM **REPLY**
My pleasure!

xboogerx says: Aug 7, 2008. 4:42 AM **REPLY**
this is awesome! I wish I had the time and a place for one of my own. good job.

Mikey D says: Aug 7, 2008. 8:30 AM **REPLY**
Thanks X