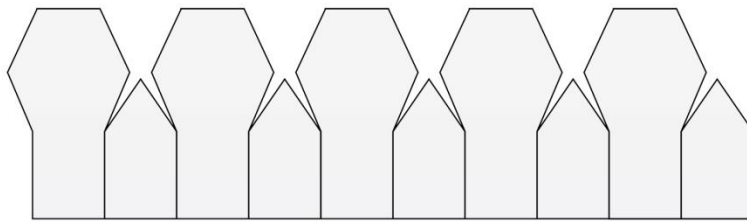
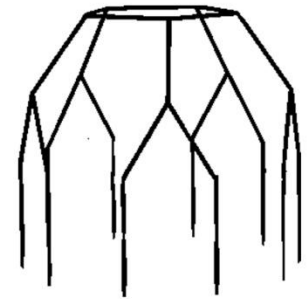


Hood



Cover Panels



Velcro



Hood Frame

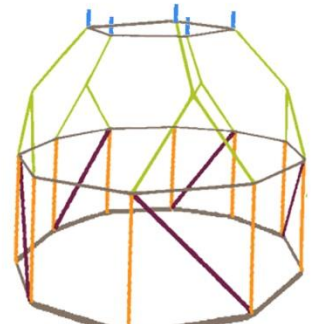
RobotGardener

Version 3.1

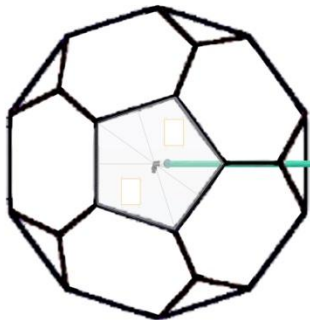


Shield

An Open Source Hardware
Raised Bed Garden Platform
with Web-Interface and
Management through Arduino.
DIY Manufacture and Assembly
Instructions available at:
www.RobotGarden.com



Dome Struts



Bed Sprinkler

Control Stand

Electronics Package

Router Box

Fertigation
Mixing Vessel

Irrigation Box



Covered Dome



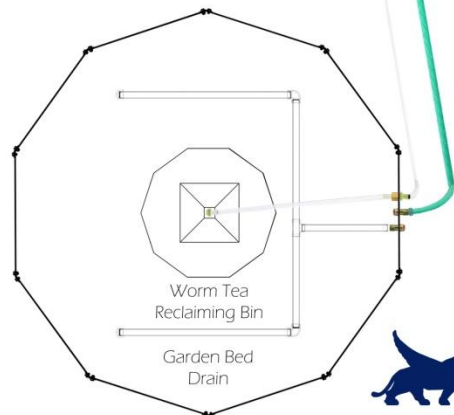
Worm Bin Cover



Worm Bin



Water Reclaiming Bed

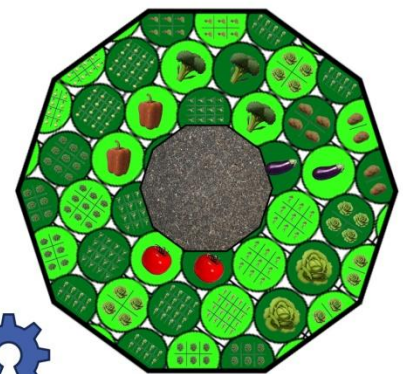


Worm Tea
Reclaiming Bin

Garden Bed
Drain



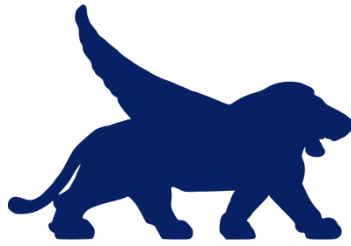
Actively Aerated Organic
Fertilizer Cabinet



Planted Garden Bed

RobotGardener Garden Bed Platform DIY Manufacture and Assembly Instructions:

1:Dome.....	3
2:Hood.....	10
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8:Fertigation Tank.....	45
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10:Bed Filling & Amendment.....	60
11: Final Assembly.....	62



1 : DOME

Materials Used:

-Steel EMT Conduit, 1", 10' (13)



-Bolts, 5/16" x 2" (30)



- Lock Nuts, 5/16" (33)



-Steel Corner Braces, 2 1/2" (3)



-Wire, 14-Gauge Steel Picture Hanging Wire (>10')



Tools Used:

-Measuring Tape



-Sharpie



-Metal Cutting Tool [Chop Saw]



-Conduit Press [and you have a variety of options, from our DIY choice, to even a hammer.]



-Drill [Drill Press]



-Drill Bit, 3/8"



-Wrench, 1/2"



-Ratchet, 1/2"



-Grinders [Belt Grinder] (Optional, Recommended) [Grinder w\ Cut-Off Wheel]



-Pliers w\ Wire Cutter



1

Wearing the appropriate safety attire cut conduit links into struts:

25 x A Struts, 2.08’;

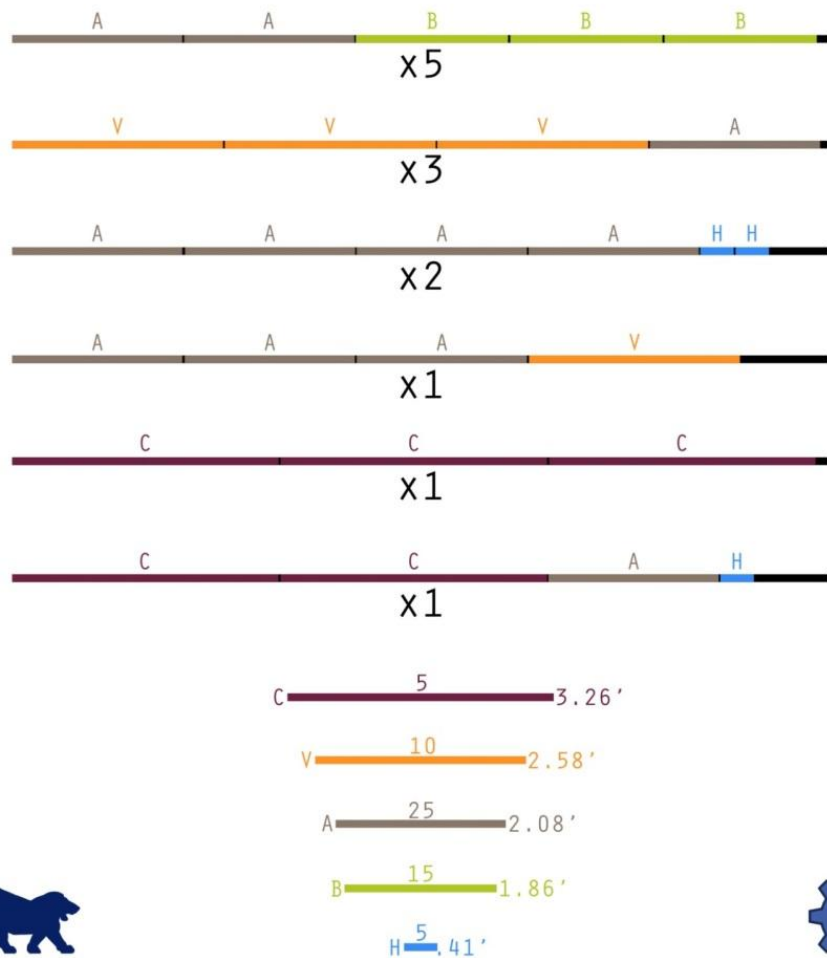
15 x B Struts, 1.86’;

10 x Vertical Struts, 2.45’;

5 x Vertical Cross Struts, 3.13’;

and 5 x Hood Support Beams, .41’.

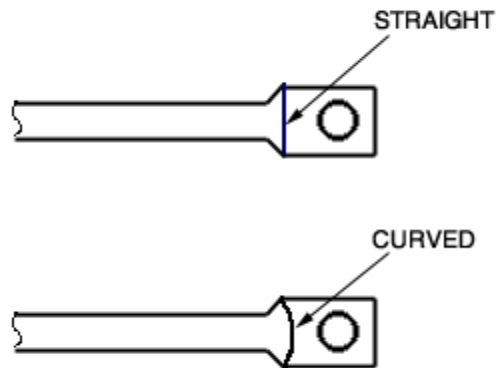
CONDUIT CUTTING, 10’ LINKS



2

Flatten both ends of each strut $\frac{3}{4}$ " from the end, level with one another, using a Conduit Press [or hammer, etc.]. Only flatten one end of the Hood Support Beams.

There will be less chance of the conduit breaking when it is bent if the ends are crimped in a curved [crescent] shape.



[Source: DesertDomes.com](http://DesertDomes.com)

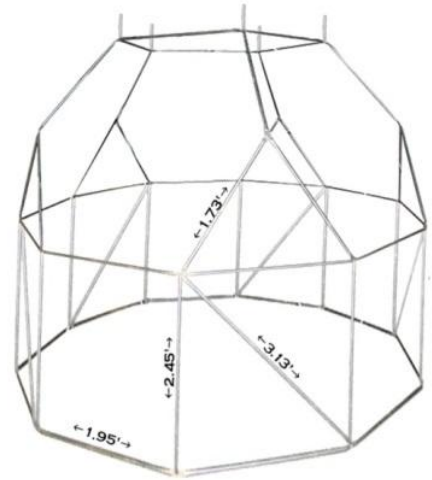
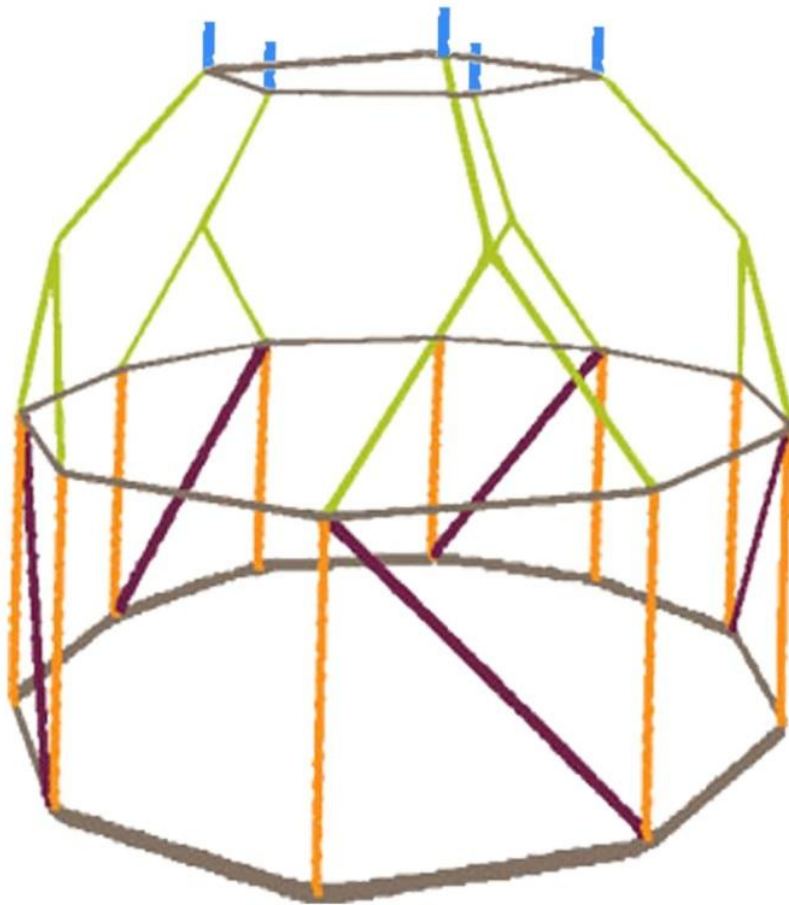
3 Use the Belt Grinder to grind any sharp edges off the ends of the flattened conduit.

4 Wearing the appropriate safety attire:
Drill a 3/8" hole in the flattened end of each piece of conduit. The hole should be centered, 3/4" from each end.

5 Use the Conduit Press (or a Table Vise, etc.) to bend the flattened ends of the A Struts, B Struts, Cross Struts, and Hood Support Beams (and Not the Vertical Struts) approximately 18 degrees in the same direction.

6 Follow the Dome Assembly Diagram to assemble the dome from the top – down.
The 2" bolts go through the intersecting conduit, directed toward the inside of the dome. The lock nuts should be located on the inside of the dome.
Hood Support Beams should sit on the outside of the intersection, next to the bolt head.
A Struts along the base of the dome should also sit on the outside of the intersection, next to the bolt head, with Vertical and Cross Struts sitting in the inside of the intersection, next to the lock nut.

DOME ASSEMBLY



HOOD SUPPORT BEAM

.41'

B STRUT

1.86'

A STRUT

2.08'

VERTICAL STRUT

2.58'

CROSS STRUT

3.26'



7

Use the wrench and ratchet to tighten all nuts and bolts securely.

8

Wearing the appropriate safety attire:

Secure the 3 Steel Corner Braces in a table vice [or alternative] before using the grinder with a cut-off wheel to halve them along their 90 degree bend.

Use the belt grinder to grind any sharp edges off the ends of the braces.

We are going to use three of these halves later in this section, while the other three halves will be used in the following [Hood] section.

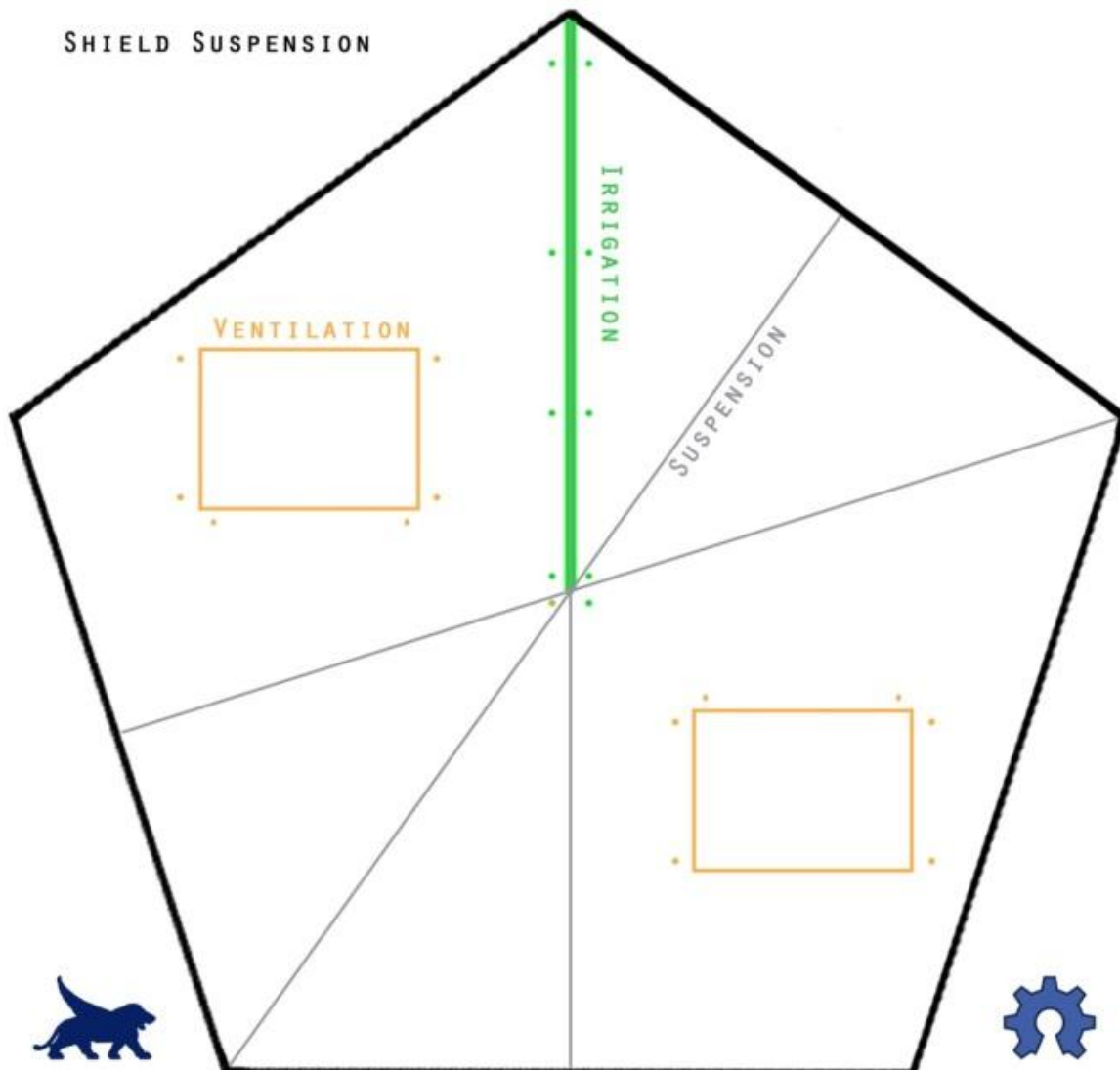
If the holes in the Corner Braces are smaller than 3/8", use the drill press and 3/8" bit to widen one of the two holes in three of the brace halves.

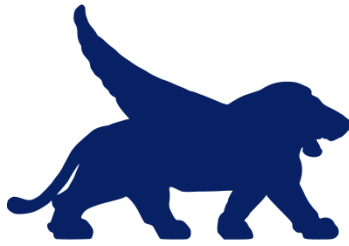
Use the Shield Suspension Diagram to determine where the three brace halves will attach in the corners of the crown of the dome.

Slide one brace half over the protruding bolt end of each corresponding intersection, with the brace half oriented upward. Use a second lock nut to hold it in place (the brace half now sandwiched between two lock nuts).

The brace half should not be sticking above the A Strut ring of conduit. If it is, bend it down and into the bed gradually until it is level with the top of the A Struts.

Run the three appropriate suspension wires between the brace halves and the center of the opposing strut, using the Shield Suspension Diagram for reference.





2: HOOD

Materials Used:

-Galvanized Flat Sheet, 2' x 3' (3)



-Rivets, 1/8" Short, 1/8" Grip Range Steel Rivet (~40-50)



-Sealant, 10.1 Oz. Aluminum Gray Latex Window and Door Caulk



-Aluminum Angle, 1/8" x 3/4" x 10'



-Corner Braces, 2 1/2" Steel Corner Braces (5) + 3 Previously Halved Brace Tabs from Dome Section



-Nuts and Bolts, 1" Zinc Plated Round-Head Machine Bolt [VP-Round Combo Machine Screws 10-24 x 1 with matching Nut] (20)



- Flat Washer, #10 x 1/2-in Zinc Plated Standard [SAE] (20)



-Wire, 14-Gauge Steel Picture Hanging Wire (<2')



-Hitch Pin, 1/4" x 3" Zinc-Plated Cotterless (3)



Tools Used:

-Sharpie



-T-Square, 4'



-Scissors, Heavy Duty



-Clamps



-Steel Plates, x 18" x 2' (2-3)



-Hand Drill



-Drill Press



-Drill Bit, 1/8"



-Drill Bit, 1/4"



-Drill Bit, 3/8"



-Rivet Tool [1/8" Compatible]



-Caulk Gun



-Metal Saw [Chop Saw]



-Screw-Driver [Philips]



-Wrench [Small adjustable]



-Pliers [w\ Wire Cutters]



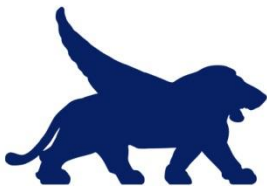
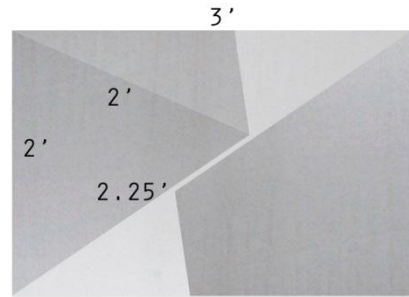
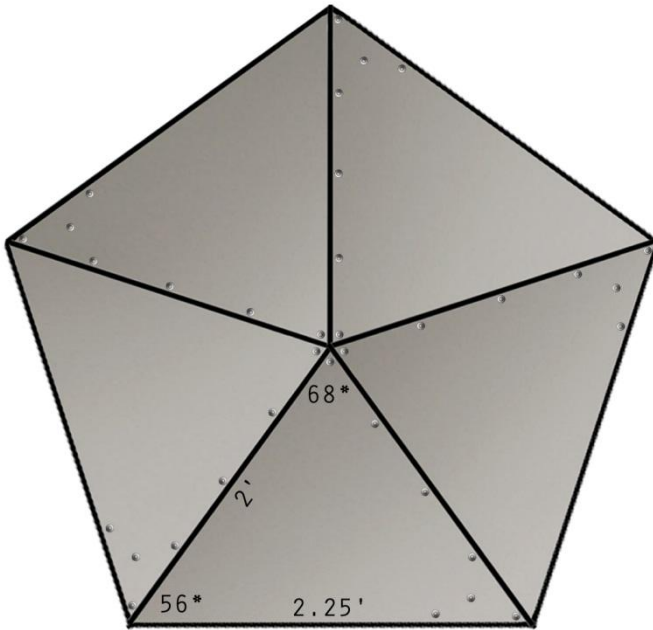
-Scraper with Razor



1

Using the Hood Panel Image, mark, then cut five 2' x 2' x 2'3" panels from the three sheets of galvanized flat sheet (using the scissors), making sure to leave their complimentary tabs attached.

HOOD PANELS



2

Using a few of the 18" x 2' steel plates that will be used in the Bed section, make a gentle bend along the 2' line between the outer-panel triangle, and its interweaving tab. Clamp the plates in-line on both sides of the prescribed line, and use your hands to gently bend the sheet (less than 20 degrees). Make sure to bend all five in the same direction.

3

Interweave the panels together, with the small tab oriented underneath, and rivet them together, making the hood. Use the hand drill and 1/8" bit (or metal punch and hammer) to make your rivet holes. Five rivets along the crest of the outer panel, and 2-3 in tab along the bottom should be enough. Make sure to rivet outside-in, pushing the rivets through from the top of the hood.

Cut a small pentagon shape, with edges approximately 3" in length, from the flat sheet scrap. Rivet the piece into the peak of the inside of the hood.

4

Cut the aluminum L-beam into five equal lengths, approximately 2' each. These pieces should also have their ends each cut at a complimentary 45 degree angle. One side of the 'L' should have both of its ends sloped 45 degrees, while the other side of the 'L' maintains its flat edge.

5

Place a corner brace near the flat ends of each piece of L-beam and mark the holes to be drilled.

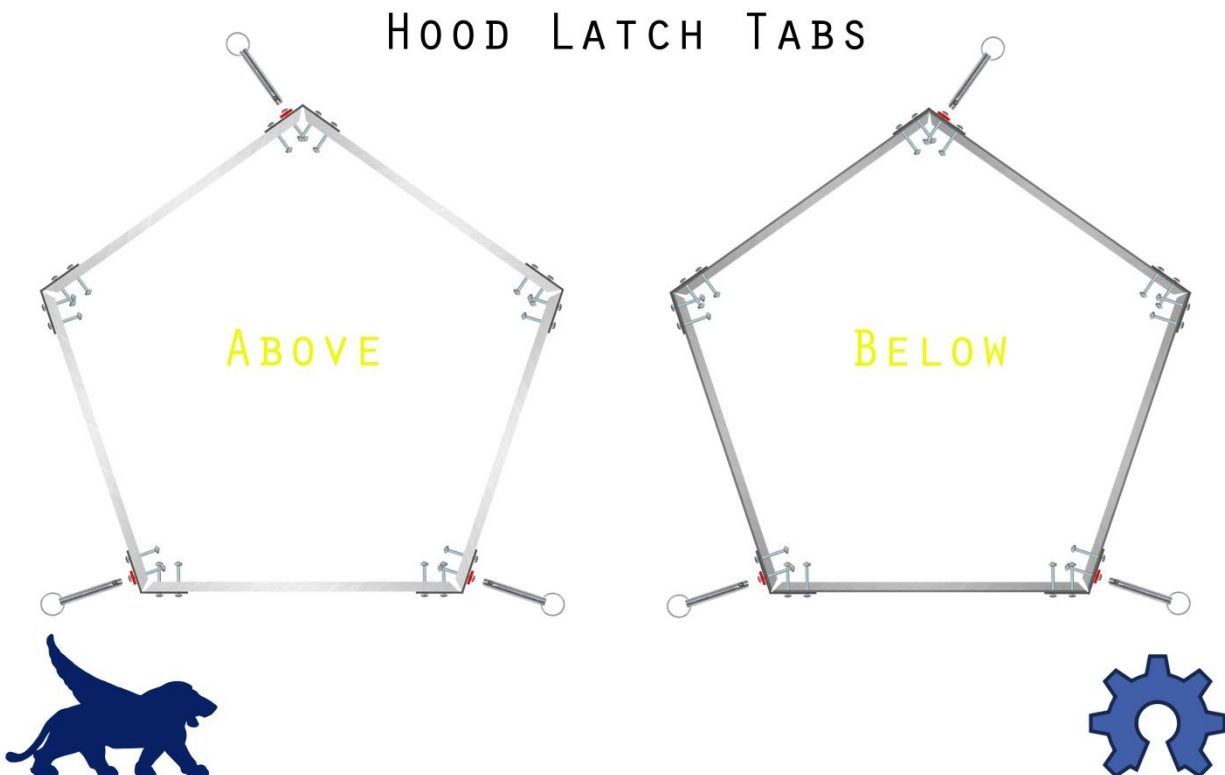
6

Use the drill press to drill the four ¼" holes in each piece of aluminum L-beam.

7

Attach the corner braces to the aluminum L-beam with the sloped edges of the beam next to one another. The screw top should be on the outside of the frame, against the brace. Once a corner's corresponding four nuts have been tightened securely, gently bend the brace open a few degrees, gradually shaping a pentagon. All of the L-beam edges should be oriented the same way, creating an inner lip in the frame.

Use the Hood Latch Tab Image to determine the proper placement of the three previously halved corner braces. These tabs mount outermost in their intersections, sitting against the machine screw's head.



8

Wire the aluminum frame into the hood. The frame should be oriented with the sloped edges\lip sitting closest to the peak, creating an aluminum rim for the hood support beams to sit in the corners of.

Use the drill to make holes in the hood, near the corner, on the interweaving panel side (going through two sheets), above and below the hood frame. Run a piece of wire through the holes and twist it securely around the aluminum frame, with the twisted ends of the wire up and inside the hood.

9

Waterproof the hood by sealing it with the caulk. Squeeze the appropriate amount of caulk between the interweaving panels, as well as into the space in the peak of the dome, underneath the small pentagonal piece.

After the caulk dries slice and\or scrape any excess off with a razor.

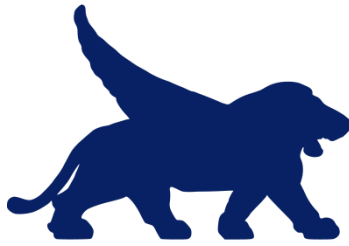
10

Place the hood onto the dome's hood support beams, bending the hood support beams as necessary to sit properly in the corners of the hood's frame.

Mark the entry and exit locations for the hitch pins on the three hood support beams corresponding to the hood's three hitch tabs.

Tip the dome on its side if necessary, and drill the 3/8" holes completely through the three hood support beams.

Once the dome is upright, the hood can be placed on top and the three hitch pins slid into place, securing the hood to the dome.



3: SHIELD

Materials Used:

-Clear Acrylic Sheet [Plexiglas], 3' x 4' (3' x 6' is what we've been having to buy)



-Wire (<5')



-Fans, 4-Sone 50 CFM Bath Fan (2)



-Full Pattern Plastic Shrub Head Sprinkler with Nozzle, 1/2"



-Plastic Swing Joint Elbow 1/2" MPT x 1/2" FPT



- 1/2" MPT - 3/4" FHT PVC Swivel



-Garden Hose



-Male Hose Repair End



-Female Hose Repair End



-Hose Washer



Tools Used:

-Sharpie



-T-Square, 4'



-Rotary Tool [Dremel]



-Dremel Carving Bit



-Pliers [w\ Wire Cutters]



-Scissors



-Screwdriver



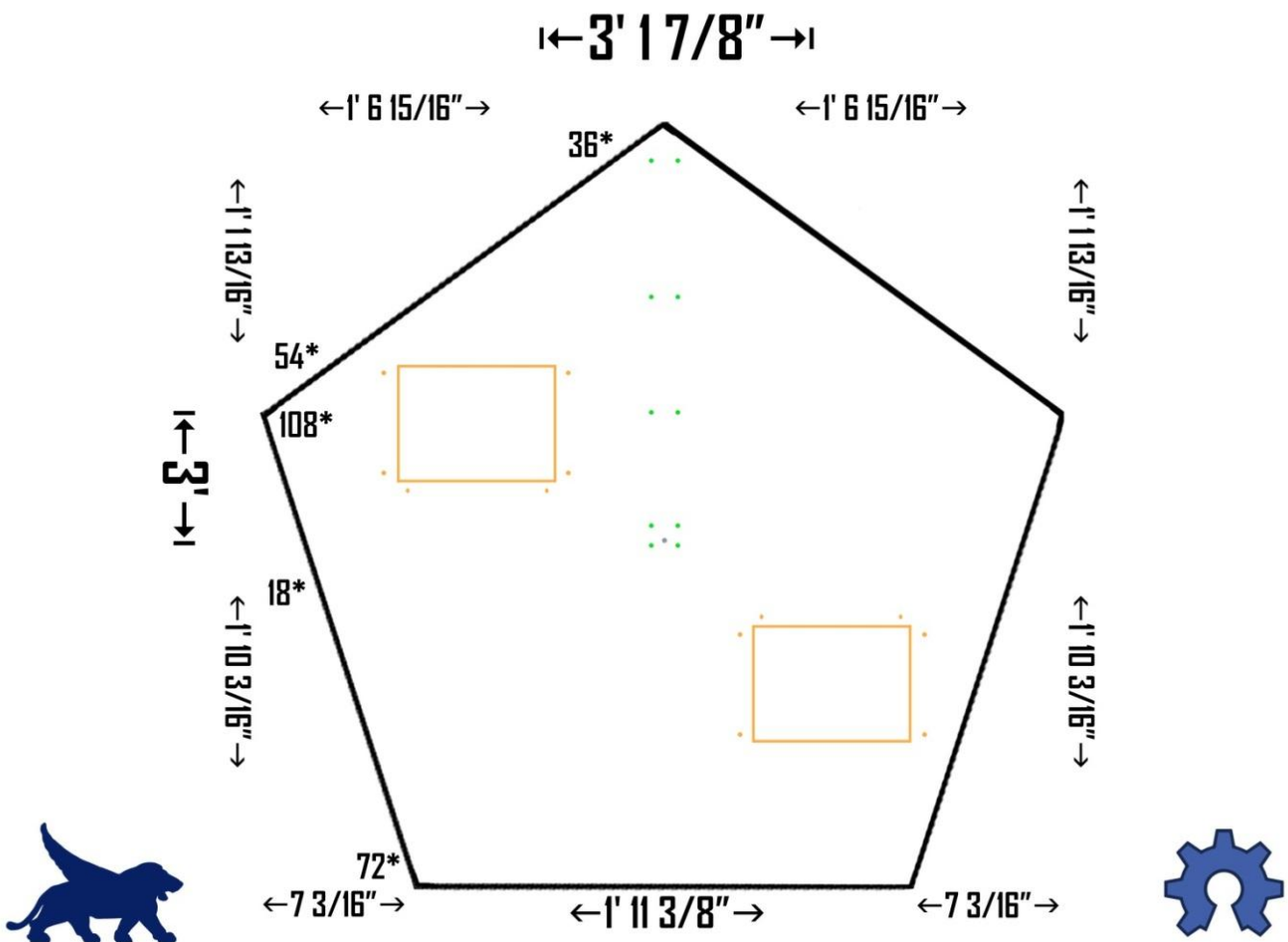
1

Use the Shield Cutting Image as a guide when drawing the pentagonal shield onto the acrylic sheet.

Take one of the ventilation fans and measure its width. Then measure a diagonal line along the fans side, running from the front of the fan, just above the fan's vent, to the bottom of the fan, around an inch from the rear. This should be the plane of the shield once the fan is mounted in place, with its vent pointed down into the dome. These measurements will be those used in marking the two ventilation ports on the acrylic sheet now.

Mark the locations for wire retention accordingly for both ventilation and irrigation.

SHIELD CUTTING

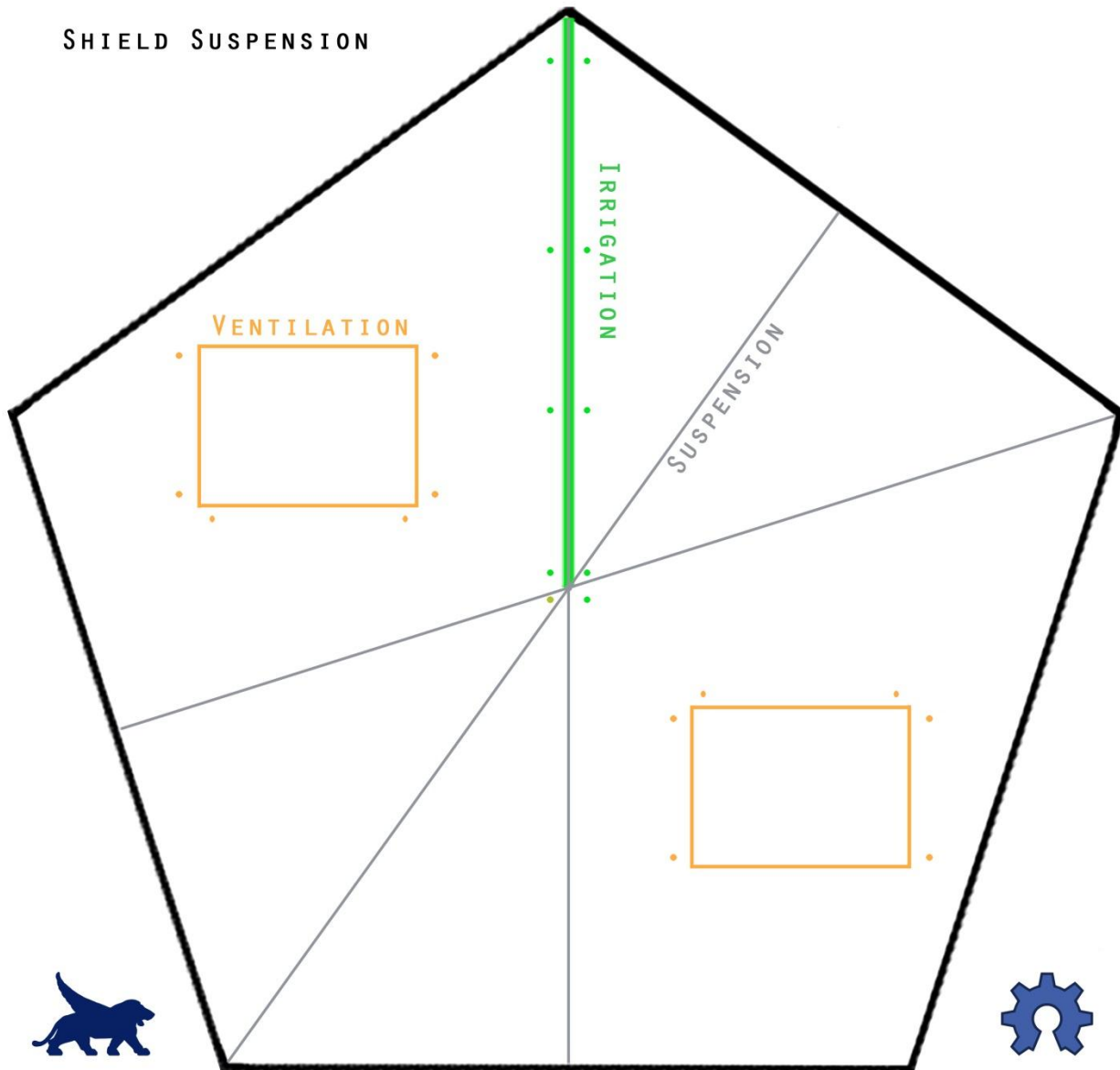


2

Wearing appropriate safety gear, and making sure to use a well-ventilated space:

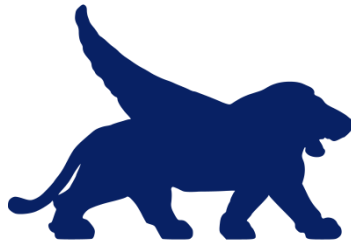
Use the rotary tool with a small carving bit to remove unwanted Acrylic Sheeting. This method takes time, as you're basically melting through the Acrylic with the spinning bit.

When the Shield is ready for installation, remove the clear plastic protective covering, and place the shield on top of the dome's suspension wires, using the Shield Suspension Diagram if necessary to properly orient fan ports and irrigation hose path.



Place the ventilation fans into their ports, facing down and inward, and wire them in place.

Next assemble the irrigation. First connect the $\frac{1}{2}$ " full pattern shrub sprinkler head, with a nozzle, to the $\frac{1}{2}$ " MNPT – $\frac{1}{2}$ " FNPT elbow. Next, connect the $\frac{1}{2}$ " MPT – $\frac{3}{4}$ " FHT PVC Swivel. You can now connect your irrigation hose. Your hose should be made to length, using the garden hose repair ends, varying based on its distance from the control stand. When the irrigation is assembled, wire it into place, with the sprinkler head oriented in the center of the shield, oriented downward over the bed. The hose leading to the control stand should also be secured to its relative B Strut on the dome, adding support.



4: WORM BIN COVER

Materials Used:

-Wood Panel, 3/4" x 24" x 36"



[-Handle, 4"-3/4" Zinc Screen Door Pull](#)



[-Drip Line 3/4" Faucet Adapter with 1/4" Barb Outlet,](#)



-Drip Line, 1/4", <4'



-Drip Line Stopper



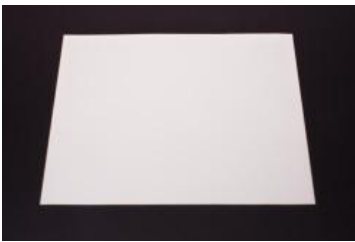
-Zip Ties (~12)



- Wood Screws, ~1"-1 ½" (4)



-Poster board, 2.5' Square



Tools Used:

-Pencil



-String (~2')



-T-Square, 4'



-Sharpie



-Circular Saw



-Sandpaper [Block]



-Screwdriver\Drill



-Drill Bit, 1/4"



1

Draw the decagonal template that will be used for manufacturing both the worm bin lid and the worm bin onto the poster board. Mount the screw into the center of the poster board. Using a 12.64" length of string connected to the screw mark the circumference with a pencil. Next mark the ten even 7.81" edges, their joints sitting along the circumference. You can use the 7.81" steel plates from the Worm Bin section as a guide.

Once the template is completed, cut off the unnecessary poster board around the decagon.

Lay the template on top of the wood panel, and mark the wood to be cut.

Set the template aside to be used in the Worm Bin section.

Mark two small rectangles in the scrap area designated for removal. These rectangular blocks should measure 1" x 7.5".

2

Use a circular saw to cut off the excess wood.

Also cut out the 1" x 7.5" wood blocks.

3

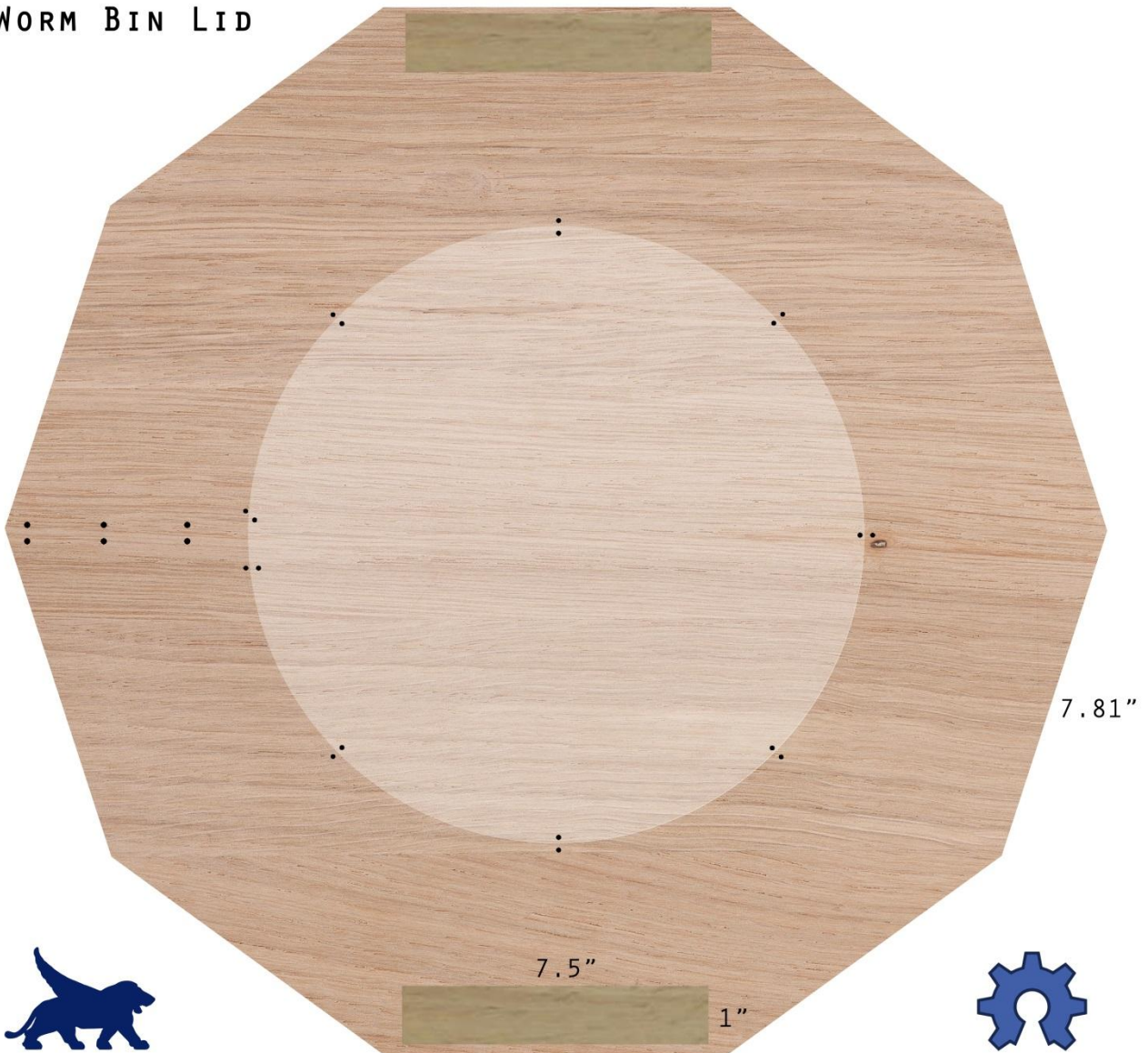
Clean up the edges of wood with the sandpaper on a block.

4

With the Worm Bin Lid Image as a guide, use the string compass to mark a circle with a 6" radius in the center of the decagonal panel. Mark a line from a corner of the decagon to the circle. Since this will be the path of our mounted dripline, which we don't want to crimp, free-sketch a gradual bend leading from the line into the circle.

Mark paired holes on either side of the path to be drilled, using the Worm Bin Lid Image as a guide.

WORM BIN LID



5

Mount the rectangular blocks in their appropriate locations using the wood screws.

Mount the handle on the top of the panel, opposite the wood blocks, centered.

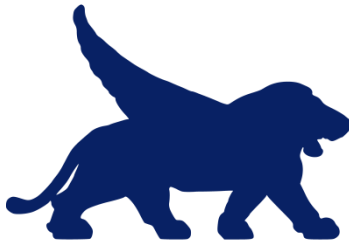
6

Drill the $\frac{1}{4}$ " drip line retention holes.

Use zipties to mount the drip line in place. The drip spouts should be oriented away from the panel, and the ziptie connection should be kept on the underside of the lid. Do not over tighten the ziptie, restricting flow.

When the drip line is mounted clip off the excess ziptie.

Place a dripline plug in one end of the dripline, and the $\frac{3}{4}$ " MHT adapter in end at the edge of the panel.



5: WORM BIN

Materials Used:

-Steel Plate, 12-Guage, 24" x 25 3/16"



-Steel Plate, 12-Guage, 6" x 7 13/16" (10)



-Steel Plate, 12-Guage, 6" x 6" (8)



-Steel Plate, 12-Guage, 12" x 9" x 9" (4)



[-3/4" x 1/2" Female Garden Hose to FIP Adapter, Brass](#)



[-1/2" Barb x 1/2" MIP Hose Adapter, Brass](#)



-Washers, >1/2" <5/8" Inner-Diameter (2)



-5-Gallon [Paint] Spreader Screen, 10" x 11"



-Bright Aluminum Screen, 14 1/4" Square



Tools Used:

-T-Square, 4'



-Sharpie



-Drill [Drill Press]



-Hole Saw, 3/4"



-Drill Bit, Anular, 1"



-Grinder [Cut-Off Wheel]



-Grinder Polishing Wheel



-Welder



-Clamps



-Table Vice



- Rotary Tool [Dremel]



- Dremel Grinding Bit



- Metal Shear



1

Use the decagon template created in the Worm Bin Lid section to mark the 24" x 25 3/16" steel plate for cutting.

Mark an 11" square in the center of the steel decagon.

Mark a 2" square in one of the peripheral spaces slated for scrap.

Mark the 9" x 9" x 12" triangular steel plates with a level 2" line between the 9" sides, designating the peak of the triangle to be removed.

2

Wearing the appropriate safety attire:

Use the grinder with the cut-off wheel to remove the predetermined excess steel: the edges of the steel decagon; the 10" square from its center; the 2" square from its scrap piece; and the peaks of the triangles, leaving a cap-less 2" edge.

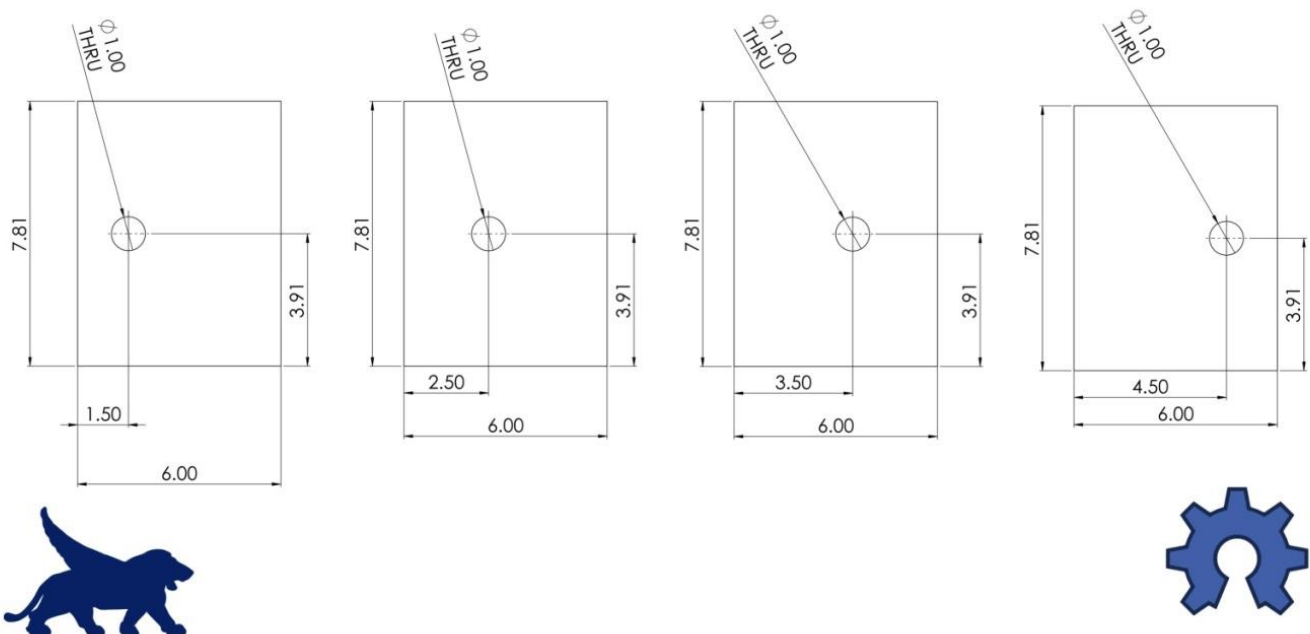
Use the grinder with the polishing wheel to clean the rough edges.

3

Wearing the appropriate safety attire:

Mark and drill the eight (or four pairs of) 7.81" x 6" steel plates with the appropriate 1" hole, using the Earthworm Porthole Image as a guide.

EARTHWORM PORTHOLES



3

Wearing the appropriate safety attire:

Weld the four modified triangular plates into a capless pyramid with a 12" square base.

Weld the 2" square onto the pyramid's cap.

Weld the worm bin porthole plates in the appropriate corresponding order to the steel decagon.

Weld the steel pyramidal drain to the underside of the worm bin's square drain port.

Weld the eight 6" x 6" steel plates to the base of the bin, paired on each side of the pyramid, making a stand.

Use the hand drill to drill a $\frac{3}{4}$ " hole in the center of the 2" square at the cap of the pyramidal drain.

4

Trim the small legs and extra length off of the paint spreader screen, aiming for a sturdy 10" square. You can use what tools are available, such as the grinder with the cut-off wheel, or an alternative.

Take an approximate 14.25" square of aluminum screening and fold it around the 10" square spreader screen, the points of the aluminum screen meeting in the center of the back side. Crease the aluminum screen firmly along its fold lines, helping it stay in place.

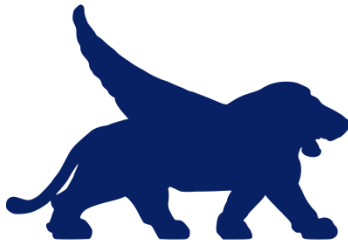
5

Clamp the $\frac{1}{2}$ " end of the $\frac{3}{4}$ " FHT x $\frac{1}{2}$ " FPT brass fixture in a table vice. Carefully remove the $\frac{3}{4}$ " end of the fixture with the grinder, using the cut-off wheel first, followed by the polishing wheel, working your way down slowly.

If the inner diameter of your fender washers is too small to fit over the $\frac{1}{2}$ " MPT, use the rotary tool with a grinding bit to increase the inner diameter.

Mount the $\frac{1}{2}$ " brass barb in the underside of the worm bin drain with a fender washer, and secure it on the inside of the drain with another fender washer and your modified $\frac{1}{2}$ " FPT brass fixture.

Place the square screen, folded aluminum edges down, into the square drain cavity.



6:BED

Materials Used:

-Slotted Angle Metal, Plated, 18-Gauge, 1 ¼" x 1 ¼" x 8' (2)



-Steel Plates, 16-Guage, 18" x 2' (10)



-Bolts, 5/16" x ½" (40),



- Bolts, 1" x 5/16" (20)



-Bolts, 1 ½" x 5/16" (20)



- Nuts, Acorn, 5/16" (40)



- Nuts, 5/16" (20)



[-Lock Nuts, 5/16" \(20\)](#)



[-Fender Washers, 5/16" x 1 1/2" \(30\)](#)



[-3/4" FHT x 1/2" FIP, Brass \(2\)](#)



[-3/4" MHT x 1/2" MIP, Brass \(2\)](#)



[-1/2" Barb x 1/2" FIP, Brass](#)



[-1/2" Barb x 1/2" MIP, Brass](#)



[-Washers, >1/2" < 5/8" Inner-Diameter \(6\)](#)



[-Pond Liner, 500 Gallon PVC/Nylon Mesh, 10' x 13'](#)



-Expanded Shale (8 x 40lb bags)



[- PVC Pipe, Schedule-40, 1" x 12'](#)



[-PVC End Caps, 1" \(2\)](#)



[-PVC Elbows, 1" \(2\)](#)



[- PVC Tee, 1"](#)



[-3/4" MHT x 1" Schedule-40 PVC](#)



-Clear Vinyl Tubing, 1/2" Inner-Diameter, 4'



Tools Used:

-Measuring Tape



-T-Square, 4'



-Sharpie



-Metal Saw [Chop Saw]



-Clamps



-Drill [Drill Press]



-Drill Bit, 3/8"



-Drill Bit, 3/4"



-Hammer [4lb]



-Wrench, 1/2"



-Ratchet, 1/2"



-Rotary Tool [Dremel]



-Dremel Grinding Bit



-Hand Drill



-Drill Bit, 1/4"



-PVC Pipe Cutter



-Scissors



-Knife



-Aquarium Grade Silicon



-PVC Glue and Primer



1

Cut the sections of slotted angle metal that will join the bed plates. When cutting slotted angle metal it is preferable to cut centered between slots, for uniformity. Place the slotted angle metal against the 18" side of a steel bed plate and determine how many slots will fit along this edge.

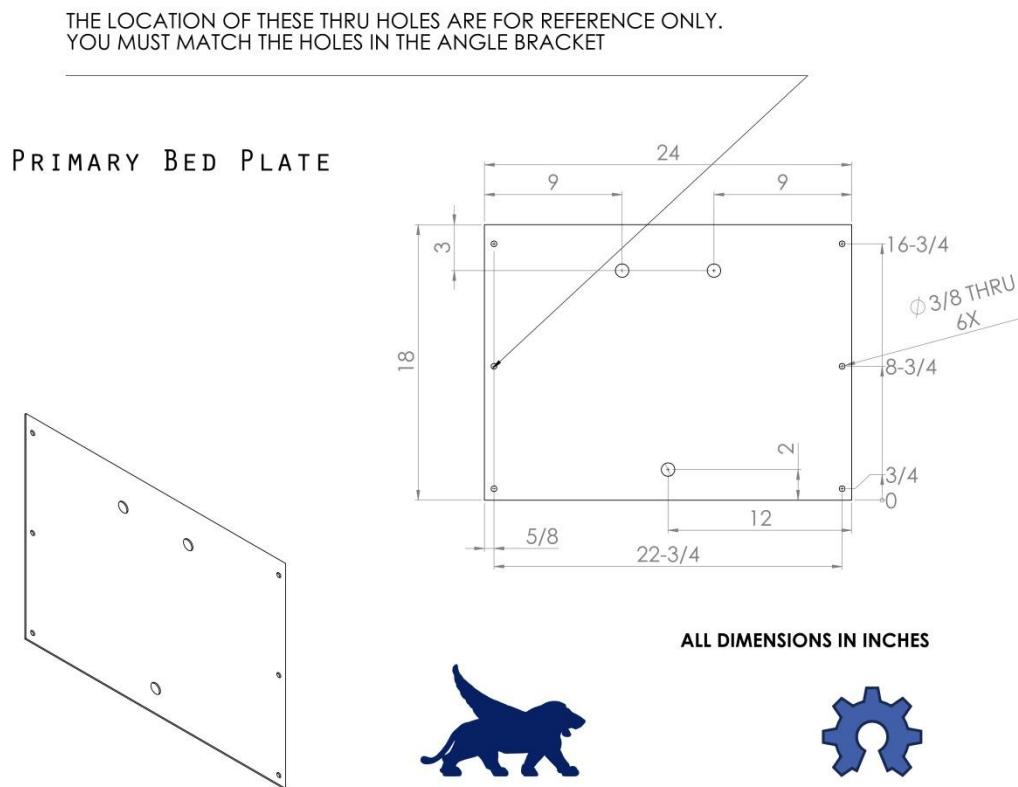
Wearing the appropriate safety attire:

Cut ten even lengths of slotted angle metal just shorter than 18" in length.

2

Place one length of slotted angle metal against the 18" edge of a steel bed plate and mark the three bolt holes to be drilled on each side, using the Primary Bed Plate Image as a guide.

Mark the three 7/8" holes to be drilled in the primary bed plate, using the Primary Bed Plate Image as a guide.



4

Wearing the appropriate safety attire:

Drill the six 3/8" holes in the bed plates. For uniformity, the plates may be clamped together, drilling the holes through all ten plates at once.

Drill the three 7/8" holes in the primary bed plate.

5

If your fender washers won't fit over $\frac{3}{4}$ " MHT, use a rotary tool with a grinding bit to increase the inner diameter to fit. You need six fender washers with a clear inner diameter.

Mount the brass fixtures in the primary bed plate, using a fender washer on each side of the plate for reinforcement. Center port that will be oriented at the top (opposite of the orientation in the image), provides a $\frac{3}{4}$ " FHT on the front of the plate and a $\frac{3}{4}$ " MHT on the back of the plate. The bottom left port provides a $\frac{1}{2}$ " brass barb on both the front and back of the plate. The bottom right port provides a $\frac{3}{4}$ " MHT on the front of the plate and a $\frac{3}{4}$ " FHT on the rear. Don't over-tighten the fixtures, as they will be removed and reinstalled during bed installation.

6

Hammer the sections of slotted angle metal from 90 degrees, as close to 144 degrees as possible.

Determine and clear the installation space:

Determine an installation location capable of providing electricity, water, and either Ethernet or Wi-Fi. Determine the future location of the control stand. The primary bed plate will sit collocated to the control stand.

Consider lighting. Is there adequate sunlight, or are you installing the appropriate spectrum of lights?

For best drainage when installing on an unlevelled surface, locate the primary bed plate at the lowest elevation. Further locate the control stand at a lower elevation than the primary bed plate.

7

Lay out the bed plates in formation, with the primary bed plate in its appropriate location. No brass fittings should be in the plate at this time. Lay the 10 sections of slotted angle metal between the plates.

Using forty $\frac{1}{2}$ " bolts and forty acorn nuts, assemble the bed. The slotted angle metal sits on the outside of the plates, against the bolt head. The acorn nut sits on the inside of the bed, seated against the steel plate. Leave the top two holes in each plate vacant, only using the bottom for holes at this time. Tighten securely with wrench and ratchet.

Install twenty $1\frac{1}{2}$ " bolts in top holes, with a regular nut.

Place the dome on top of the $1\frac{1}{2}$ " bolts, with the irrigation directed toward the primary bed plate. Adjust bed wall placement to suit dome.

Remove the dome without disturbing bed wall placement, and remove the twenty $1\frac{1}{2}$ " bolts from the top of the bed wall, leaving them empty.

8

Put a layer of fill dirt or sand into the bed before laying pond liner in centered. Gently push the liner down to the base of every plate, keeping a relatively even amount of excess hanging over the edges. Fold the Liner when necessary to avoid bunching.

Pour a few bags of expanded shale into the lined bed, 2"-3".

Install the brass fittings back into the primary bed wall. While making sure to keep the pond liner properly situated, use a knife to cut a small circular hole in the pond liner directly over the primary bed wall port, large enough to barely force the threaded end of the brass fixture through with some force. Apply a fairly generous amount of the aquarium silicon to the inside of the washer that will be seated against the pond liner, and install the brass fittings in their appropriate locations, tightening securely.

9

Cut the 1" PVC pipe into five lengths: two 3' lengths, one 2'3" length, one 1'9" length, and one 1'6" length.

Drill a series of ¼" holes in a straight line along the tops of the pipe, leaving the last couple inches of pipe undrilled. Rinse, and remove PVC shavings.

Place 1" end caps on one end of the 3' lengths. Place a 1" elbow at the opposite end of the 3' lengths. Place the 2'3" length in the open end of one of those elbows, and the 1'9" length in the other. Connect the 2'3" and 1'9" lengths, in-line, using the straight of the 1" tee. Connect the 1'6" length to the remaining opening at the bottom of the 1" tee. The drain should resemble an off-center goal post.

The bed drain will connect to the bottom right port of the primary bed plate. With that in mind glue the pieces together with holes oriented down. After drying, rinse well.

Place the drain in the bed, drain holes down. Thread the ¾" MHT to 1" PVC adapter tightly into the ¾" FHT brass fixture in the bottom right of the primary bed plate, and glue the 1" PVC drain to the adapter.

Attach the ½" clear vinyl tubing to the brass barb on the inside of the primary bed plate, located on the bottom left side, and run enough length reach the center of the bed and up a few inches to connect to the worm bin drain.

10

Add the other bags of expanded shale, just covering the bed drain, and the vinyl tubing.

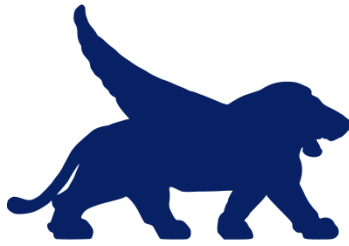
Connect the clear vinyl tubing to the ½" brass barb at the base of the worm drain, allowing the tubing to sit between stand plates as the worm bin is placed in the center of the bed, on top of the expanded shale. The corners of the worm bin are pointed at the centers of the bed walls.

Fill the bed with soil and compost. Reference Bed Filling section.

11

With the bed properly filled, install twenty 1" bolts in the bed's twenty top holes. Pull the liner into place over the top of the bed. Make a small hole on either side of the liner and force the bolt through. A 5/16" fender washer can fit onto one of the two entering bolts on the inside of the bed. Tighten twenty lock nuts securely with the wrench and ratchet.

Trim off the excess pond liner, leaving a few inches of overhang evenly around the edge.



7 : PANELS

Materials Used:

- Hook and Loop Adhesive-Backed Reclosable Fastener [Velcro, 3M [SJA-7501](#) & [7502](#)], 1" Wide x 50 Yards (1 Roll Each)



- [Plastic Sheeting, Clear, 6 Mil, 10' x 25'](#)



- [Sun Screen Fabric, Green, 6' x 40'](#)



Tools Used:

-T-Square, 4'



-Sharpie



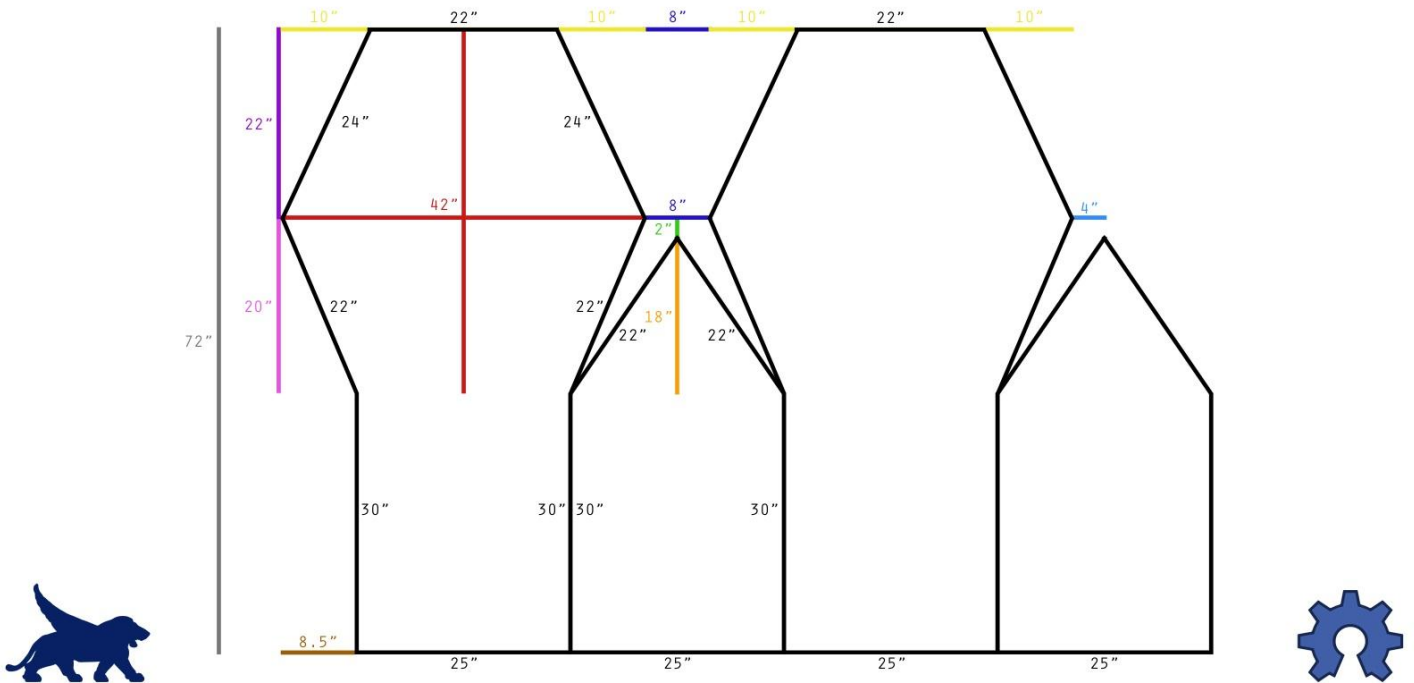
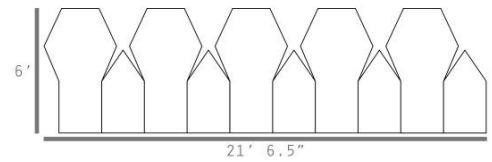
-Scissors



1

Using the Panels Image as a guide, draw the ten cover panels onto the material.

PANELS



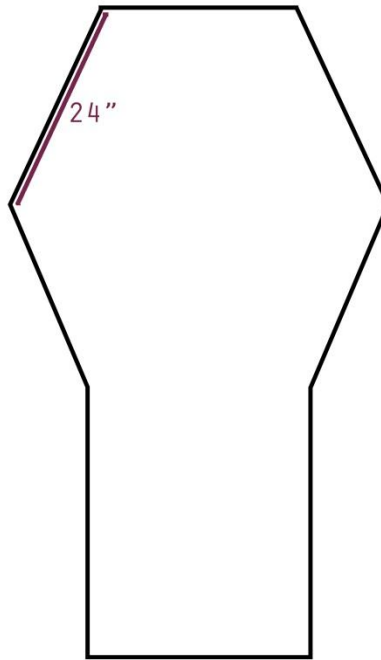
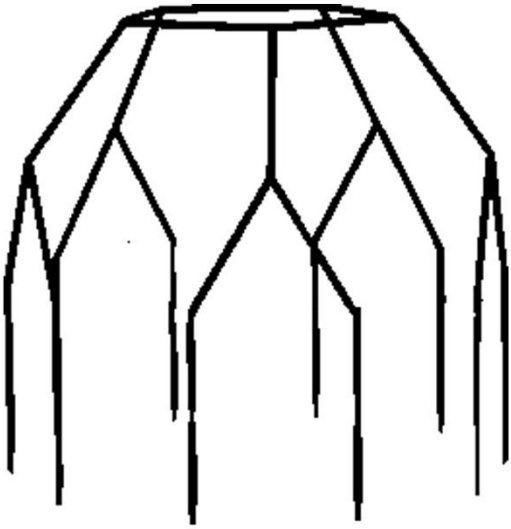
2

After all ten of the panels have been drawn on the material (five with hexagonal tops and five with triangular tops), cut the panels out with scissors. Cut away from the material, not into it, as you don't want any small slits that could lead to tears later.

3

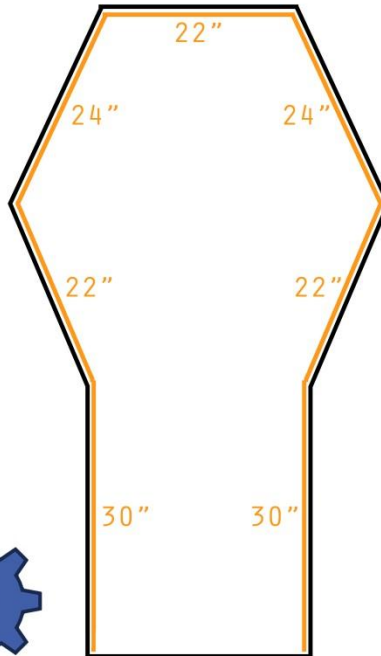
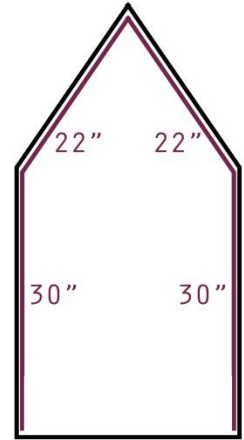
Using the Panel Velcro Image, place the appropriate length of either hook or loop Velcro on each panel in appropriate locations. Use scissors to cut the length, then remove the adhesive protection before pressing firmly in place along the edge of the panel. The Velcro should sit right along the panel edge, not hanging over the material, and not letting the material have an overhang.

VELCRO



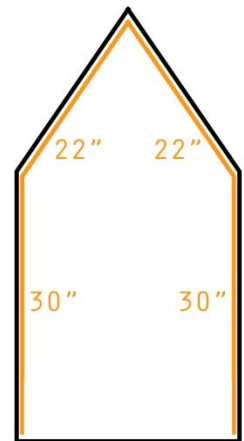
OUTER

HOOK



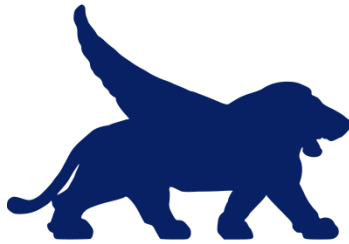
INNER

LOOP



Lay hook Velcro along the crests of the corresponding struts on the dome: along the tops of the A Struts at the top of the dome, just under the plexiglass; on the outer crests of all the B struts; and along all the crests of the Vertical Struts. Press the adhesive firmly to the steel conduit to affix.

Now Velcro the panels to the dome. The triangular panels go on first. The hexagonal panels go on second, with their top edges velcroing just under the plexiglass shield (its weight holding the panels secure), and the upper left edge weaving under the hexagonal panel adjacent. Press all the Velcro firmly together once it is in place.



8: FERTIGATION TANK

Materials Used:

-2" Threaded PVC [Cleanout w/ Plug](#)



-3" x 2" [PVC Bushing](#)



-3" x 3" x 1 1/2" x 1 1/2" [PVC Double Tee](#)



-3" [PVC Pipe, 2'](#)



-1 1/2" [PVC Pipe, ~2'](#)



-1" [PVC Pipe, ~1'](#)



[-3" x 1 1/2" PVC Coupling](#)



[1 1/2" PVC Elbow](#)



[1 1/2" x 1" PVC Bushing \(2\)](#)



[-1" Inline PVC Check Valve \(2\)](#)



[-3/4" MHT x 1" PVC Adapter](#)



[-3/4" FPT x 1" PVC Bushing](#)



[-3/4" FPT x 1 1/2" PVC Bushing](#)



[-3/4" MPT x 3/4" FHT Swivel](#)



- $\frac{3}{4}$ " MHT x $\frac{3}{4}$ " MPT



Tools Used:

-PVC Primer and Glue



-PVC Pipe Cutter



1

Assemble the fertigation tank in three sections.

The initial irrigation check valve system is first. Glue the $\frac{3}{4}$ " MHT x 1" PVC adapter into the inlet end of a 1" inline check valve.

2

The lower mixing vessel is next. Glue the 2' of 3" PVC pipe into the 3" x 1 $\frac{1}{2}$ " coupling. Glue the ~2" of 1 $\frac{1}{2}$ " PVC pipe into the end of the coupling, before gluing the other end into the 1 $\frac{1}{2}$ " elbow. A 1 $\frac{1}{2}$ " x 1" bushing is then glued into the open end of the elbow.

3

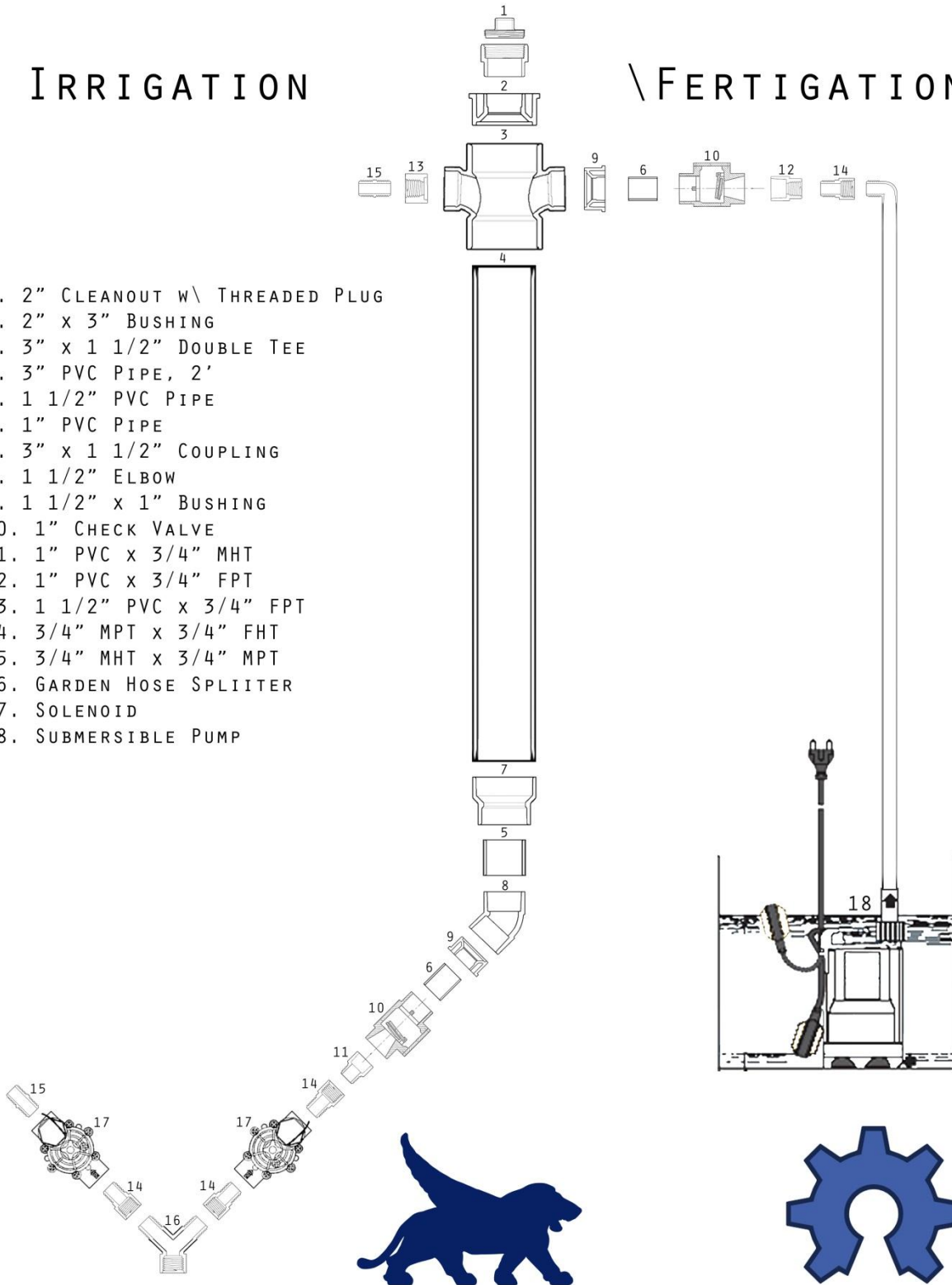
Last is the upper mixing vessel. Glue the 2" threaded cleanout with plug into the 2" x 3" bushing. Glue that 3" bushing into the top of the double tee. Thread the $\frac{3}{4}$ " MPT x $\frac{3}{4}$ " MHT into the $\frac{3}{4}$ " FPT x 1 $\frac{1}{2}$ " bushing, and glue the bushing into one side of the double tee. Glue the $\frac{3}{4}$ " FPT x 1" bushing into the inlet of the second 1" inline check. Use the pipe cutter to cut a ~2" length of 1" PVC pipe, and glue it into the outlet end of the 1" inline check. Glue the remaining 1 $\frac{1}{2}$ " x 1" bushing into the other side of the double tee, before gluing the 1' section of PVC pipe protruding from the inline check into the bushing.

The fertigation tank will be left in sections until its alignment is properly marked in future sections.

IRRIGATION

FERTIGATION

1. 2" CLEANOUT W\ THREADED PLUG
2. 2" x 3" BUSHING
3. 3" x 1 1/2" DOUBLE TEE
4. 3" PVC PIPE, 2'
5. 1 1/2" PVC PIPE
6. 1" PVC PIPE
7. 3" x 1 1/2" COUPLING
8. 1 1/2" ELBOW
9. 1 1/2" x 1" BUSHING
10. 1" CHECK VALVE
11. 1" PVC x 3/4" MHT
12. 1" PVC x 3/4" FPT
13. 1 1/2" PVC x 3/4" FPT
14. 3/4" MPT x 3/4" FHT
15. 3/4" MHT x 3/4" MPT
16. GARDEN HOSE SPLITTER
17. SOLENOID
18. SUBMERSIBLE PUMP





Materials Used:

-Galvanized Flat Sheet, 2' x 3' (4)



-Steel Corner Braces, 1 1/2" (8)



-Galvanized Roofing Nails, 3/4"



-Fender Washers, 5/16" x 1 1/2" (16)



-Steel EMT Conduit, 3/4", 10'



- Channel, Half Slot, 14-Gauge, 10'



-Universal Pipe Clamp, 3/4" (8)



-Door Hinge, 3", with 1/2" Screws (2)



- Plywood, 1/2", 4' x 8'



-Bolts, 5/16" x 2" (10)



- Bolts, 5/16" x 4" (2)



U-Bolt [Square], 6" x 3/8"



-Lock Nuts, 5/16" (12)



-Lock Nuts, 3/8" (2)



-Wood Screws (~40)



-Irrigation Valve Box, 12" x 17"



- Junction Box, PVC, 12" x 12"



- 3/4" FHT Y-Splitter to 2 x 3/4" MHT



- 3/4" FHT x 3/4" MPT Swivel (3)



- 3/4" MHT x 3/4" MPT Adapter



-Electric Water Solenoids, 3/4", In-line w\ Flow Control (2)



-Hose Washer (8)



-Wire, 14-Gauge Steel Picture Hanging Wire (~2')



-RobotGardener Electronics Package



Tools Used:

-T-Square, 4'



-Sharpie



-Pencil



-Circular Saw



- Metal Cutting Tool [Chop Saw]



-Hammer



-Scissors



-Rotary Tool [Dremel]



-Dremel Cut-Off Wheel



-Wrench, 1/2"



-Ratchet, 1/2"



-Screwdriver\Drill



- Drill Bit, 3/8"



- Drill Bit, 7/16"



-Hole-Saw, 1"



-Hole-Saw, 1 3/4"



-Hole-Saw, 2"

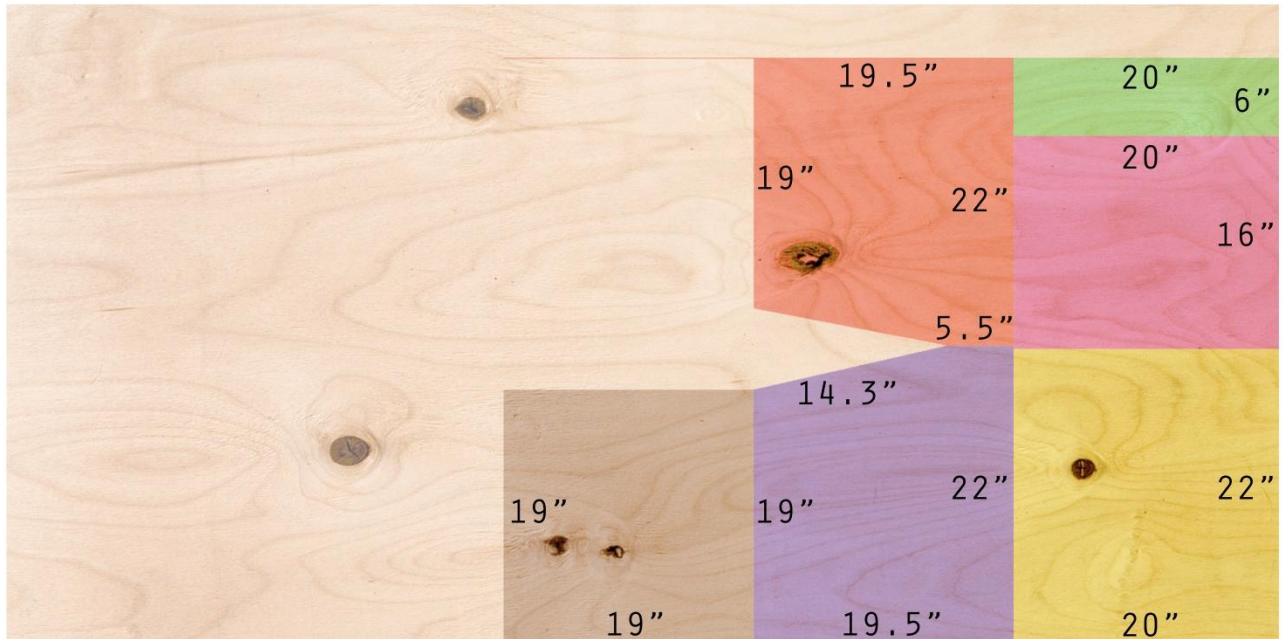


1

Wearing the appropriate safety attire:

Using the Wood Cabinet Image for reference, cut the plywood into six pieces with the circular saw.

WOOD CABINET



Using a Metal Chop Saw: Cut the 10' link of $\frac{3}{4}$ " Conduit into 4 even 2 $\frac{1}{2}$ ' lengths; Cut two 42" lengths of half-slot channel. For uniformity, make cuts centered between slots.

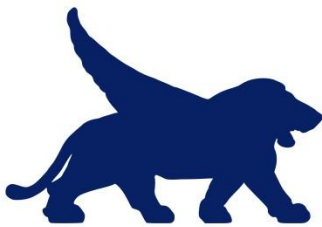
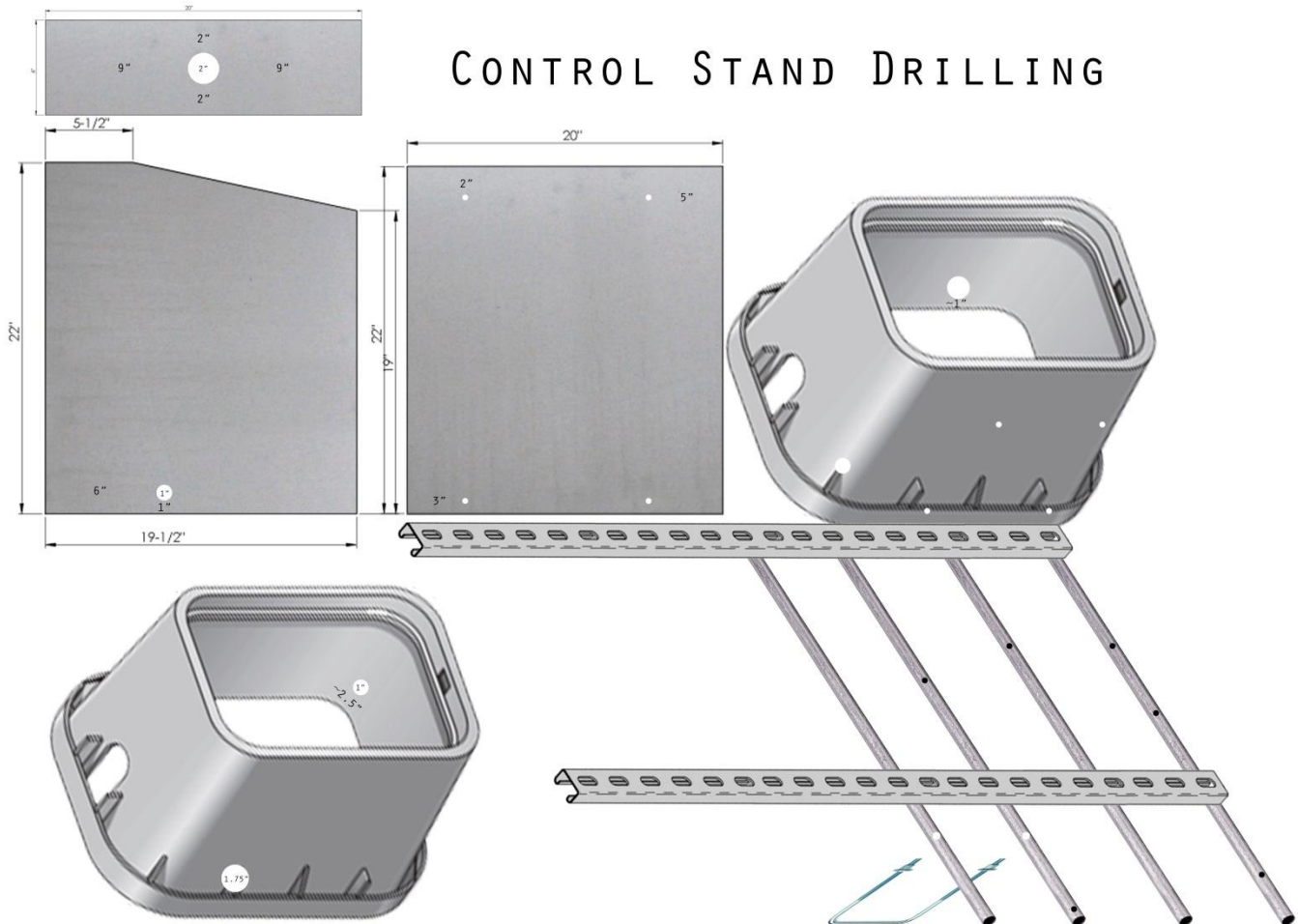
Again, when cutting bracketing, for uniformity it is important to cut lengths on centers between holes. I'm cutting 2 lengths of approximately 42" off the ends of the piece so I get both of the polished ends.

2

Assemble the wood cabinet using the corner braces to frame it. Use the [Control Stand Plywood Assembly](#) Video for reference. Place two corner braces between the rear cabinet wall and each of the sides. Place one corner brace between each side wall and the cabinet's front wall. Place one corner brace between the cabinet's top and each of the side walls. Once the cabinet is framed place a number of wood screws along the outer face of each corner for reinforcement.

Use the Dremel and cut-off wheel to cut off any screw points that might be left protruding after corner brace installation.

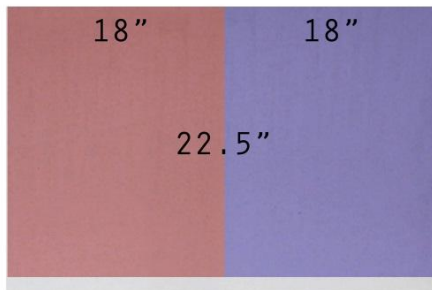
Using the Control Stand Drilling image as a reference, drill the appropriate 3/8", 1", and 2" holes in the wood cabinet.



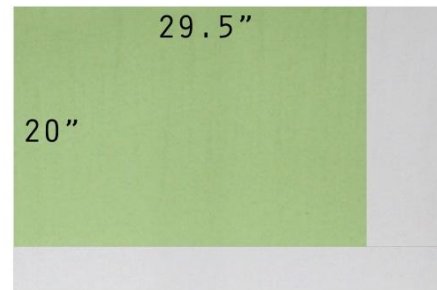
Drill the appropriate 3/8" holes in the back of the irrigation box. Also drill the appropriate 1" hole along the back left corner of the irrigation box (left side when facing the 3/8" holes drilled). The 1" hole should be centered on the crest of the corner, ~2 1/2" up.

Using the Cabinet Metal Sheeting image, mark and cut three of the four sheets.

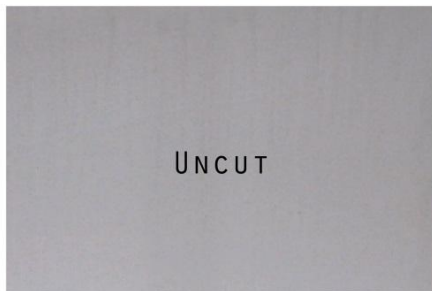
CABINET METAL SHEETING, 24" x 36"



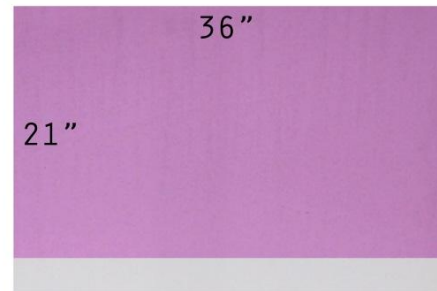
SIDES



BACK/TOP



FRONT



LID



Cover the wood cabinet with the galvanized sheeting. Tack the bottom edge of the sheet in position on the under edge of the wood cabinet using the hammer and roofing nails, before shaping the sheet over the cabinet's corners, working toward the cabinet's opening. Tack any excess sheeting inside the cabinet. Cover the cabinet's lid in the same fashion.

Use the drill and appropriate bits to remove the sheet metal from the pre-drilled 3/8", 1" and 2" holes.

Attach the two lengths of channel to the rear of the cabinet. When facing the rear of the cabinet the channel should be flush with the left side of the cabinet's rear and extending to the right, with the open face of the channel facing away from the cabinet. Slide fender washers into the channel's end, before sliding a 5/16" bolt through the washer, channel, the pre-drilled 3/8" holes in the cabinets, and another fender washer on the inside of the cabinet. Secure the bolt snugly on the inside of the cabinet with a lock nut.

Mount the irrigation box on the opposite end of the channel in the same fashion, placing fender washers into the channel before sliding the bolts through the washer, channel, irrigation box holes, and another washer on the inside of the irrigation box. Secure the bolt on the inside of the irrigation box, but not so much as to bend it upward and off the ground.

5

Attach the four pieces of conduit to the channels using the universal pipe clamps. Use the Control Stand Drilling image as an estimation on their placement.

Place the fertigation tank mixing vessel in place between the 1st and 2nd conduit beams. This portion of the mixing vessel hasn't been glued together yet. Use a ~6"-8" piece of 1" PVC pipe extending from the elbow at the bottom of the mixing vessel by placing it into the 1" entry port on the corner of the irrigation box. When the lower mixing vessel is seated comfortably on the channel and into the irrigation box, adjust the unglued tee of the upper mixing vessel to sit inline with channel. Draw a line down this connection on the PVC to mark its placement for future gluing. Twist the length of wire around the mixing vessel and the 1st and 2nd beams to hold it in place temporarily.

Connect the irrigation solenoid assembly. Connect two 3/4" female hose to 3/4" MPT swivels to each male end of the hose splitter, before threading the swivels into the inlet end of the two electric water solenoids. The solenoid that leads left has the outlet end threaded with the 3/4" MPT to 3/4" MHT adapter, while the solenoid on the right has its outlet end threaded with a 3/4" MPT to 3/4" female hose swivel. Thread the initial check valve portion of the fertigation tank that was glued in the last chapter to the 3/4" female end of the swivel at the outlet end of the right solenoid.

Place the irrigation solenoid assembly into the irrigation box. When facing the front of the irrigation box: The female end of the splitter should be sitting under the front of the box; the left solenoid should be exiting open end at the left of the irrigation box; and the initial check valve system should be inline with the temporary piece of 1" PVC leading to the fertigation tank.

When the irrigation solenoid assembly has been properly aligned: Mark the position of the female end of the hose splitter on the outside of the irrigation box; Mark the 1" PVC pipe leading to the mixing vessel where it should be cut to fit properly into the initial check valve system. After the irrigation box and pipe have been marked, remove the irrigation solenoid assembly.

Drill a 1 3/4" hole, centered, 1 1/2" above the spot marked for the splitter placement.

Remove the fertigation tank. Withdraw the temporary piece of 1" PVC pipe and cut it to the appropriate length. Glue the 1" PVC pipe in the open end of the elbow at the base of the mixing vessel. Glue the 3" tee to the top of the 3" pipe, in the position marked. Once the connections have dried, rinse the mixing vessel very well.

Place the empty outdoor box on the top edge of the top piece of channel, with its back against the 3rd conduit beam. The connection tabs of the outdoor box should be extending to the sides, the holes in the tabs sitting centered over the 2nd and 4th conduit beams. Readjust the location of the 4th beam if necessary; the 2nd beam must remain 6" from the 1st beam. Mark the locations of the two holes to be drilled. Place the empty 1' outdoor box on the back of the control stand: its back against the 3rd conduit beam; the connection tabs of the outdoor box should be extending to the sides, the holes in the tabs sitting centered over the 2nd and 4th conduit beams;

just under the universal pipe clamps connected to the top channel. Mark the two holes to be drilled in the conduit for the box connection.

Using the Control Stand Drilling image: Mark the 1st and 2nd conduit beams along the rear crest ~7" from the top of the beam (these two locations will have 7/16" holes while all the rest will have 3/8" holes). Mark the 3rd and 4th beams along the rear crest ~8" from the bottom. Mark the irrigation box ~8" from the bottom in line with the 3rd and 4th beams.

Drill the six 3/8" holes in columns 2-4, and the two 7/16" holes in columns 1 and 2.

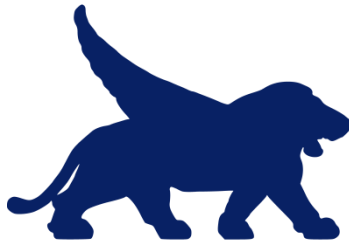
Place the fertigation tank back in place on the control stand, with the 1" PVC pipe entering the irrigation box. Secure the vessel in place by sliding the 6" square u-bolt across the tank and through columns 1 and 2, securing it with the 3/8" lock nuts on the front of the conduit. Glue the initial check valve to the 1" PVC pipe on the inside of the irrigation box. After it has had time to dry, connect an incoming hose to the initial check valve, and an outgoing hose to the male thread at the top of the mixing vessel, and rinse the fertigation tank well with water.

Place the 4" bolts through the two bottom holes on the 3rd and 4th beam, and slide them into the holes drilled in the side of the irrigation box. Secure the bolts in the inside of the irrigation box with a washer and a lock nut. Do not over tighten.

If the empty PVC junction box does not have a 1 3/4" porthole already drilled on its underside, drill that hole centered. Install the empty router box to the back of the control stand, sliding a 5/16" bolt through the connection tabs, then through the conduit on the 2nd and 4th beams, before securing it with a lock nut. Install the RobotGardener Electronics Unit to the front of the control stand, securing the 5/16" bolts on the rear of the 2nd and 4th beams with a lock nut.

Taking the 6 1/2" wide piece of scrap metal sheeting, cut a 7" x 6" rectangle. Mark the center of the bottom 7" edge. Place the irrigation solenoid assembly into the irrigation box with the primary female swivel exiting the port drilled on the front left of the box. The metal sheet will have a narrow channel cut into it so it can slide over the splitter's main section, behind it's swivel, creating a choke to keep it extended. Place the bottom edge of the sheet into the outer rim along the base of the irrigation box and mark the height from the centered base mark to the top of the splitter piece, not its swivel. Also measure the width of the width of the splitter piece, which should be smaller than the swivel, and mark this width centered from the base to the height mark, rounding the top of this channel to sit on the splitter's neck.

Completion of the Control Stand and its installation will be in section 11, Final Assembly.



10:BED FILLING & AMENDMENT

Materials Used:

-Soil (¾ cubic yard)



-Compost (¾ cubic yard)



-Humate [Optional]



-Zeolite [Optional]



-Dragonite [Optional]



-Cow Manure, Fresh (~3-4 Gallons)



[-Earthworms \[Red Wiggler\] \(25-As many as possible\)](#)



Tools Used:

-Shovel



1

Fill the bed with an even mixture of soil and compost.

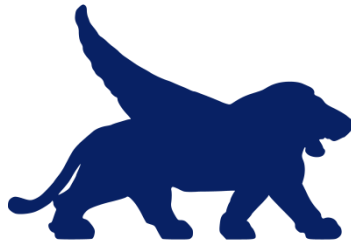
Mix in a few cups of each amendment into the top eight inches of bed soil, turning the compost and soil with the amendment to spread it evenly.

2

Put ~3.5 gallons of fresh cow manure into the worm bin and spread it evenly, just covering the opposing first series of portholes.

Place the earthworms on the manure, and replace the lid on top of the worm bin.

As the earthworm population multiplies over the coming months, add another layer of fresh cow manure to the bin, covering a porthole during each feeding. When the worm bin is full mix its castings, earthworms, and earthworm eggs into the garden bed, and begin the feeding process from the beginning. Either set aside the worms and eggs necessary to repopulate the bed, or leave the bottom layer of worms, eggs, and castings in the bin to do the job.



11:FINAL ASSEMBLY

Materials Used:

-Garden Hose



-Male Hose Repair Piece (3)



-Female Hose Repair Piece (3)



-1/2" Inner-Diameter Vinyl Tubing



-Aquarium Pump Tubing, ~3'



[-Air Stone](#)



[-Aquarium Pump](#)



[-Submersible Pump \[1/6 hp\]](#)



[-5 Gallon Food Grade Bucket](#)



[-1 Quart Container](#)



[-Rubber Grommet, 1/2" Inner Diameter](#)



[-Small Metal Screw \(4\)](#)



-Small Wood Screw



-Hose Washer (~10-12)



[-Router, Linksys WRT54GL](#)



[-Garrett Juice](#)



Tools Used:

-Screwdriver\Hand Drill



-Drill Bit, 5/8"



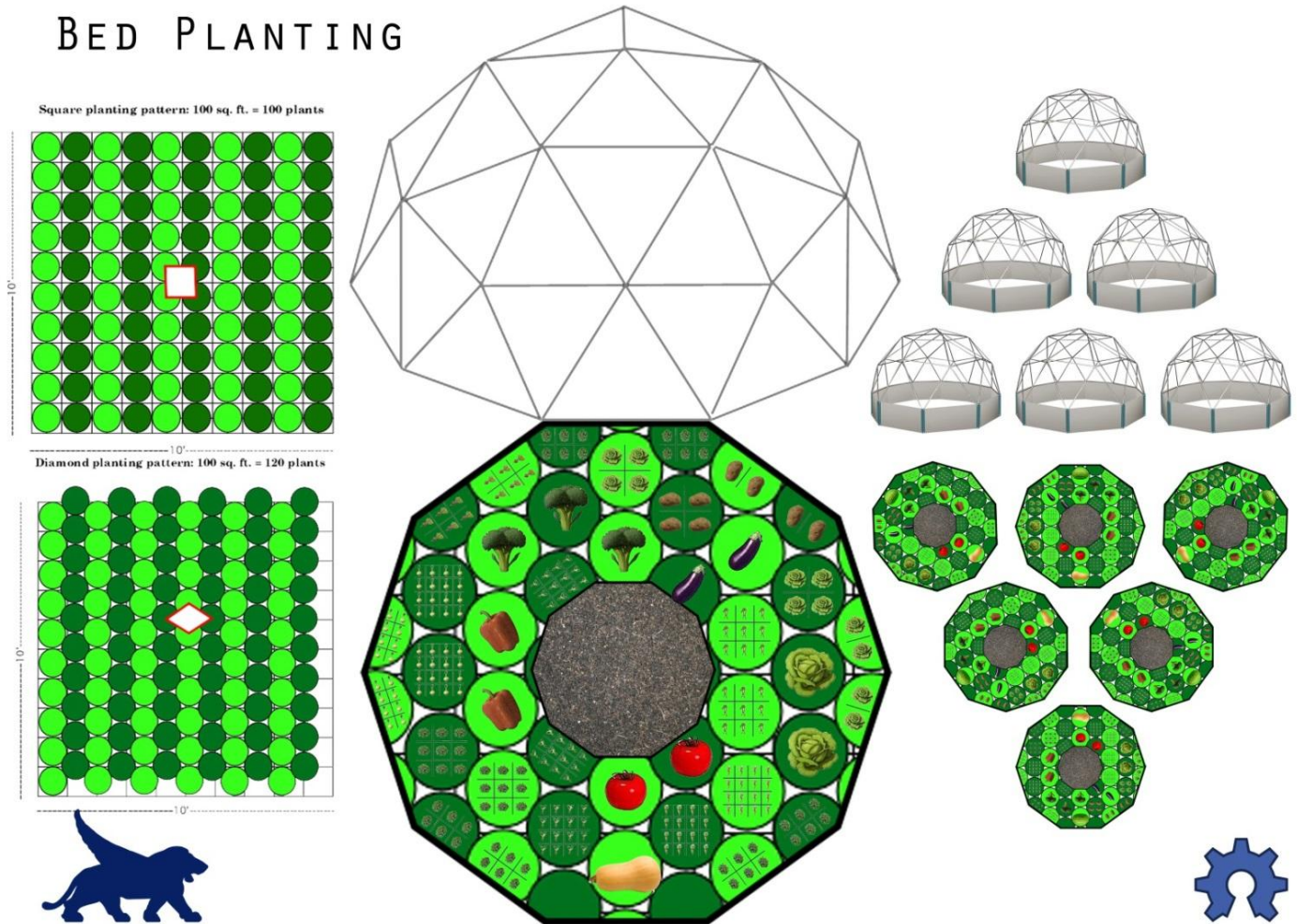
-Scissors



1

Using the Bed Planting image for reference, as well considering additional instructions for increasing the success of a planting, plant the garden bed, following seed spacing instructions found on seed packet.

BED PLANTING



2

Place the dome in place on top of the bed, with the dome irrigation hose centered over the primary bed plate.

Place the control stand next to the bed, with the irrigation box end oriented perpendicular to the primary bed plate.

Connect the irrigation hose to the male outlet port at the top of the fertigation tank.

Install the irrigation solenoid assembly in the irrigation box. Thread the right solenoid onto the fertigation tank. Pull the main water connection swivel through its port in the irrigation box, before sliding the sheet metal collar down over its neck. Secure the sheet metal in place by placing 4 small metal screw in each of the sheet's corners.

Make a short garden hose (~2.25'), and connect it between the worm bin lid and the [top] brass fixture on the inside of the primary bed plate. Make another short garden hose and connect the top brass fixture on the outside of the primary bed plate to the irrigation solenoid exiting the left side of the irrigation box.

Connect the clear ½” vinyl tubing to the outlet barb of the primary bed plate. Run the hose into the side of the irrigation box, under both solenoids, through the opposite end of the irrigation box, and through the 1” porthole drilled in the side of the fertigation cabinet. Leave ~3.5’ of tubing inside the cabinet.

Drill a 5/8” hole in the side of the 1 quart container approximately 1” up from the bottom. Place the rubber grommet in the hole. Connect the 1 quart container to the end of the clear vinyl tubing inside the cabinet.

Install the aquarium pump inside the cabinet in the top left corner. The aquarium pump should have its air-port facing down. Run the electric cord out the 1” porthole [or 2” porthole if necessary].

Place the bucket in the cabinet, so that it isn’t sitting on the vinyl tubing, and the 1 quart container can be lifted at an angle to pour its contents into the bucket at a later date.

Place the submersible pump into the bucket. Connect ~3’ of aquarium pump tubing to the air stone. Place the air stone in the bottom of the bucket and connect the other end of the hose to the aquarium pump. Run submersible pump’s electric cord out of the 1” porthole [2” porthole if necessary].

Make and connect a short garden hose between the submersible pump and the fertigation mixing vessel, with the hose running through the 2” porthole in the top of the cabinet.

Install the router in the PVC junction box on the back of the control stand. Run the appropriate amount of each wire through the porthole in the bottom of the junction box, before screwing the top back onto the box.

Install the various sensors inside RobotGardener. Moisture sensors are placed in the soil of the garden bed and in the manure in the earthworm bin. Temperature sensors go inside the dome covers (as shaded as possible).and inside the worm bin lid. Additional sensors may also be installed now.

3

Plug all the devices sensors to their various connections: particular electric plugs (RobotGardener main, router, pumps, fans, etc.) , solenoid connections, sensor connections, and internet.

You can now make a batch of actively aerated organic fertilizer solution. There are any number of ways to mix this solution to promote varying microorganism populations. Please read *Teaming with Microbes* by Jeff Lowenfels and Wayne Lewis (www.teamingwithmicrobes.com) to get a strong understanding about the soil-food-web, and how populations of microorganisms interact with plants. We add a couple gallons of clean water to the bucket, and an adequate amount of Garret Juice. Make sure the aquarium pump is on and the solution is aerating. This solution should be used in a timely manner before another batch is made.

4

Once everything has been properly connected a full functions test can be performed.