

Modified Smaller Growing Tower System

Author/Source: Mel Sikes, Adam Low (design)



Tools Needed (Fig. 1):

- Drill (preferably cordless) (A)
- 1-5/8" Hole Saw Drill Bit
- Marker
- Dremel Tool and Cutting Blades (B)
- PVC cutting tools (C)
- 7/8" Hole Saw Drill Bit
- Copies of the Stencils (end of directions)
- 1/4" Drill Bit
- Heavy Duty Scissors
- Ruler/Tape Measure
- **Protective Safety Eyewear for all!**

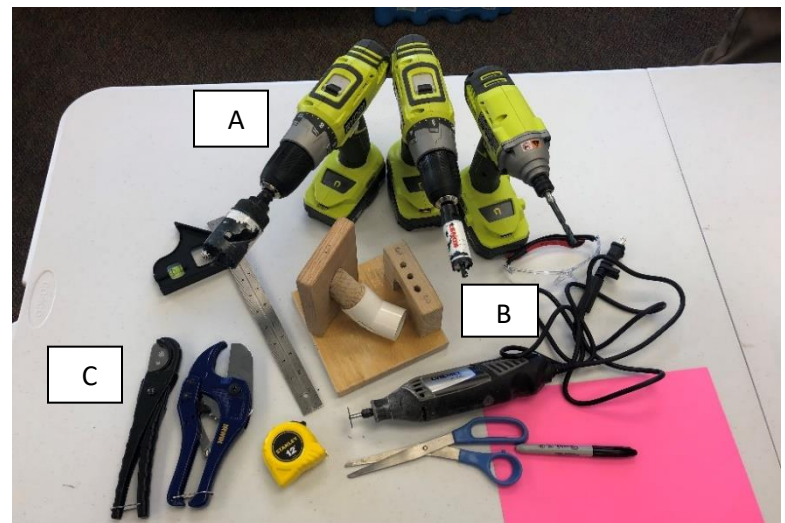


Fig. 1

Materials Needed (Fig. II):

- 2-Gallon Buckets (x3)
- 5-Gallon Bucket (1)
- 5 Gallon Bucket Easy-Off Lid (1)
- 2-Gallon Bucket Easy-Off Lids (x3)
- 1/4" Stainless Steel Wing Nuts and washers (x6)
- 1/4" x 1" Stainless Steel Hex Bolts (x6)
- 1/2" PVC Pex tubing (37")
- 1" 45° PVC Elbows (x16)

Or substitute pool noodles cut to fit

- 158-200 GPH Submersible Water Pump
- 2 Ft. LED Light Fixture (x4) **if you are growing indoors**
- Hot Glue Gun and Glue Sticks or Plumber's Silicone (optional or possibly necessary)
- Scrap piece of wood to drill on so you don't ruin your table or floor.
- * **There are different types of bucket lids. Be sure to get the sturdiest lids you can find. It needs to hold the weight of the plants and the buckets.**



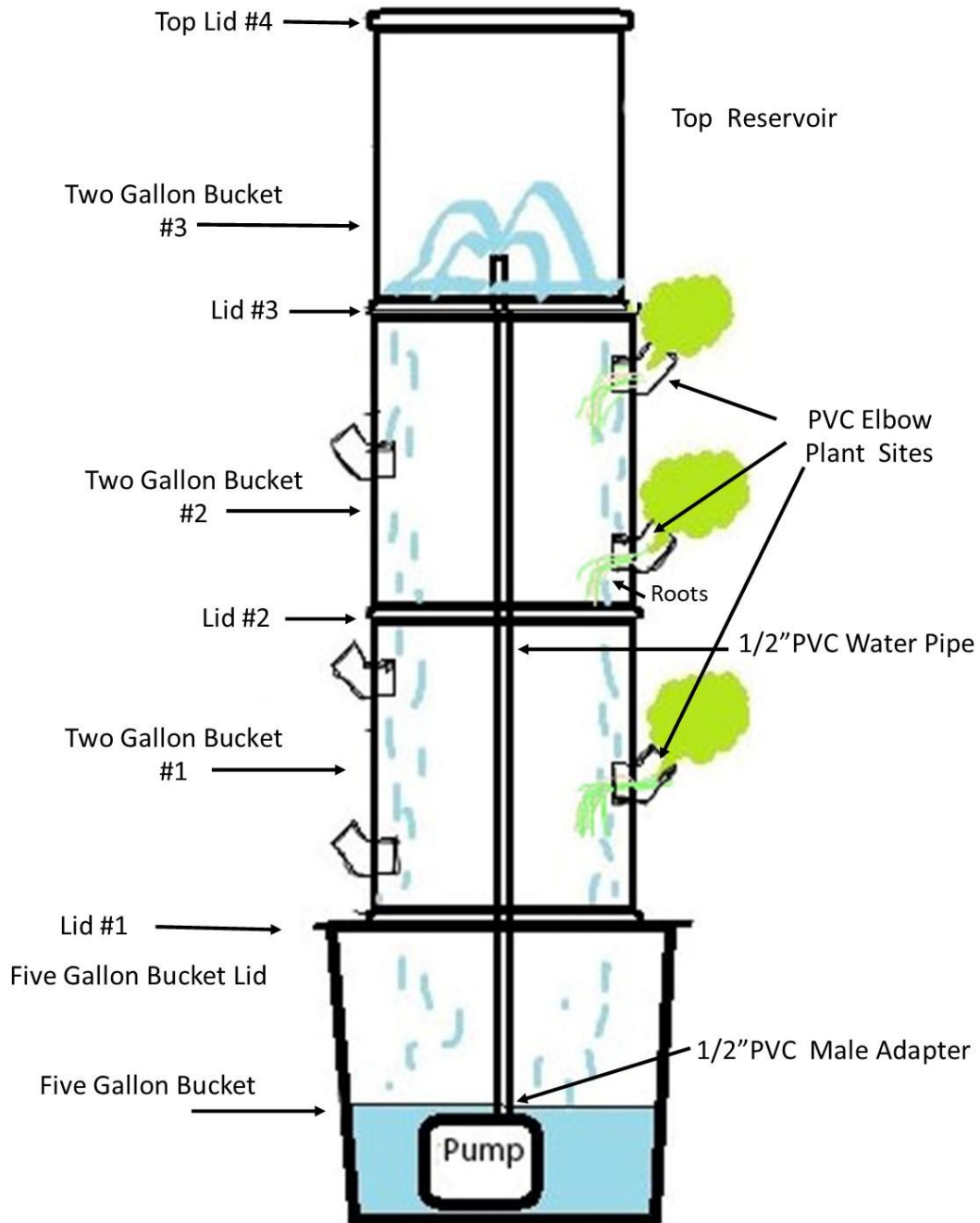
Fig. II

Materials for Light Supporting Structure:

- 1" PVC Pipe – 4 4' lengths and Eight 21 1/2" lengths
- 1" 90° PVC Elbow Sockets – 8
- 2 2'x2' pieces of plywood for top and bottom
 - **Note: if you add wheels to the bottom plywood, it will make it easier to move**
 - **Note 2: If you are using this outside, do not put plywood on top of the structure. Add string, rope or some other security measure to keep the wind from blowing the plants over.**
- Light Attachment – Wire, Rope, String, Metal U-Bolts, zip ties if using lights
- 1 6 spot surge protector power strip – **if using attached lights**



Diagram of Modified Grow Tower without using the top bucket for planting



Stage 1: Preparing the plant sites

- 1-1:** Remove the handles from all buckets and assign and write on each 2 gallon bucket a number noting its position in the tower (i.e. #1 is the bottom bucket, #3 is the top bucket).
*****Set aside #3...Don't mark up this one!*****

Note: by extending the ½" pvc water pipe to near the top of bucket number 3, and adding a 360 degree sprinkler head, you can use the top bucket for growing also.

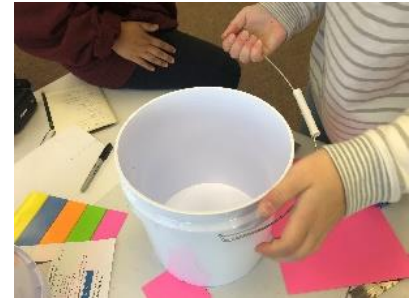


Figure 1-a

- 1-2:** Using the Stencil A (found at the end of these instructions) you will mark the 2 gallon buckets where the plant sites will be drilled. First poke a hole at the sites A, B and C with a pencil. Then lay the template flush with the lid of the top of the bucket and mark the three holes through the stencil with the sharpie. Move the stencil over to match up hole A on the stencil to the spot you marked for hole C and repeat the marking until you have 8 spots marked on the bucket. Repeat the marking for the second bucket. (remember the 3rd bucket should not be marked)



Fig. 1-b

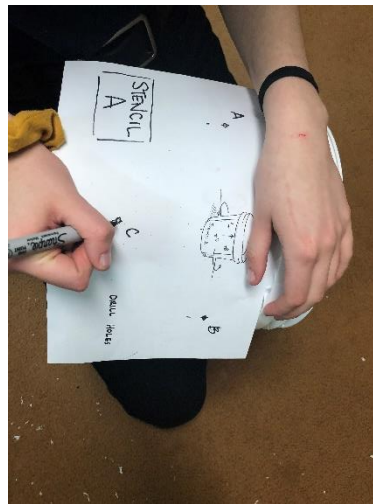


Fig. 1-c



Fig. 1-d

1-3: Prepare the drill with the 1 5/8" Hole Saw.



1-4: Cut out the plant sites on the 2 buckets using the 1-5/8" hole saw. *Be sure to wear safety eyewear for all drilling steps, anyone nearby should wear safety eyewear also.*



Fig. 1-e



Figure 1-f



Figure 1-g

Stage 2: Preparing the Connection of the Buckets

2-1:

Prepare the Dremel Tools with a cutting blade.



Fig. 2-a

2-2: Look for the circles in the center of the bucket bottoms. Flatten any dimples in the plastic in the middle of the circle using the Dremel tool *Be sure to wear safety eyewear for all power tool steps, anyone nearby should wear safety eyewear also.*



Fig. 2-b

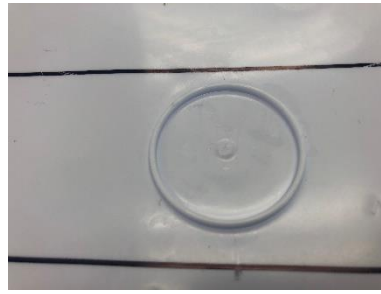


Fig. 2-c

- 2-3: Mark the bottom of the bucket using the Stencil B (found at the end of the instructions). Using the Dremel, cut away two large sections leaving just a strip of plastic where the water line and bolt holes are situated.**



Fig. 2-d



Fig. 2-e



Fig. 2-f

- 2-3: Mark two of the 2 gallon bucket lids using Stencil C. Do not cut holes in the 3rd lid, that is the top lid. Put the 3rd lid aside. Prepare the drill with 7/8" hole saw. Using the drill and the 7/8" hole saw, cut a hole for the water line in the center of the 2 bucket lids.**



Fig. 2-g



Fig. 2-h

- 2-4: Remove the hole saw and put the 1/4" drill bit on the drill. Create the drainage holes the bucket lids using the 1/4" drill bit. Drill the two holes for the bolts.**



Fig. 2-i



Fig. 2-j



Fig. 2-k

2-5: Lay the lid on top of the bottom of the bucket. Use the sharpie to mark the hex bolt spot on the bottom of the bucket through the lid. Drill the two symmetrical holes on the bottom of the bucket. Make sure the holes line up. Connect the two with hex bolts, wing nuts and washers.

Note: I suggest leaving out the centre row of holes, and drilling holes all the way around. I would drill matching holes in the bottoms of the top three buckets.



Fig. 2-l

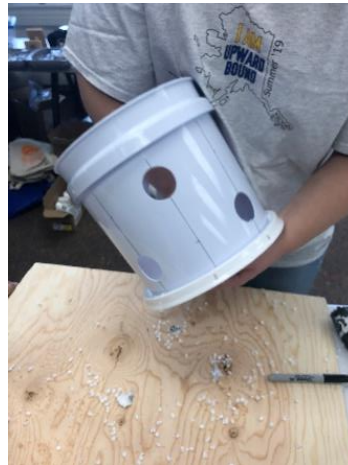


Fig. 2-m



Fig. 2-n

Stage 3: Preparing the 5 gallon Bucket

3-1:

Prepare the lid of the 5-gallon bucket. Place the 2-gallon bucket in the center of the lid and use a sharpie to mark the circumference, the half circle drainage holes of the bottom of the 2-gallon bucket and the attachment holes of the bucket with a sharpie. Drill drainage holes in the 5-gallon lid inside the two half circles.



Fig. 3-a



Fig. 3-b



Fig. 3-c

3-2: Drill the center hole with the 7/8" hole saw.



Fig. 3-d

3-3: Create two symmetrical holes to bolt the lids to the buckets above them in the tower. Rinse away all plastic debris and bolt each lid to the bottom of its respective bucket.



- 3-5 Use the 1 5/8" hole saw to cut a hole in the 5-gallon lid for the electric cord for the pump.



Fig. 3-g

Stage 4: Prepare and install plant site elbows

- 4-1: Drill 3 holes in the top of each PVC elbow as pictured below. Uniform placement of holes is not necessary as long as they are in a location that water falling from the top of the tower can drip through. Using the 1/4" Drill Bit, drill three holes into the top of each PVC elbow to allow water to reach the plant roots. The holes should be positioned so that they are completely inside the tower when the elbow is inserted into the bucket. *This step is tedious, but also necessary to deliver water to your plants inside the tower.* Note: this step is unnecessary if you use pool noodles.



Optional: Create a jig out of wood to hold the elbow in place while drilling. (Fig. 4-c and 4-d)
Note: this step is not necessary if you use pool noodles.



Fig.4-c



Fig. 4-d



Fig. 4 e



Fig. 4 f



Fig. 4 g

4-2: After cleaning the plastic debris away, insert each elbow or pool -noodle into each of the plant sites that were created in step 1-4. It will be a tight fit so be forceful.

4-3: Now it's time to check the seals. If you need to, fire up the glue gun or use the plumber's sealant. Create a seal around each elbow to the bucket. Be sure to create an even seal all the way around the elbows. Do this step indoors or in a heated area to reduce the risk of cracking the buckets. Be sure there is proper ventilation for fumes. *This step is not necessary if you use pool noodles. See illustration.*



Fig. 4-h



Fig. 4-i



Figure 4.j

Suggested pool noodle use.

Stage 5: Set up the Water Line and Assemble the Tower

5-1: Connect the threaded male PVC adapter that comes with the pump to one end of the PVC Pex tubing pipe.



Fig. 5-a



Fig. 5-b

5-2: Place the pump in the bottom of the 5 gallon bucket and screw in the PVC pipe. Slide the tower base assembly down the pipe and feed the pump cord through the hole you drilled for it in step 2-2.



Fig. 5-c



Fig. 5-d

5-3: Once the bucket base is snugly in place, simply stack your buckets in the order that they are numbered and firmly snap each lid to the top of the next bucket. Be sure that the top bucket has a lid on it as well. You can add additional cone washers to the PVC tube at each lid juncture to stabilize the pipe. Add a funnel to the top part/bucket of the pipe to help distribute the water evenly to the sides. Note: If you use the top bucket as an additional growing area, the funnel is unnecessary.



Fig. 5-e



Fig. 5-f

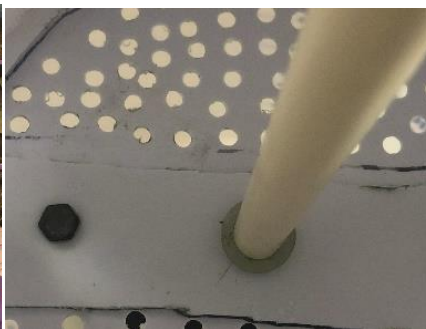


Fig. 5-g



Fig. 5-h



Part II: How to Produce Results with Your Grow Tower

So you have built a brand new vertical grow tower with your own hands... *Now what?*

Things to consider and choices to make:

Crop Selection: The first choice to make is which crop you will grow in your tower as this will determine what type of fertilizer and potential lighting needed to get results. The Chena Grow Tower was originally created with the intention of growing lettuce and this choice may be the easiest for beginners, but the possibilities are much greater. The tower can produce spinach, arugula, mustard greens, strawberries, several herbs and many other options.

Fertilizer Selection: The fertilizer chosen should cater to the preference of the crop chosen (Lettuce is happy with something around 8-15-36). Some fertilizer brands such as DynaGrow or *The Urban Farm Fertilizer Company* have fertilizer products specifically designed for various crops. If you can't find a fertilizer specifically designed for your crop just take to the internet to find out what levels of N-P-K fertilizer are right for your plant and find a general use N-P-K fertilizer at your local home & garden store that is close to the levels your plant desires. **No matter what fertilizer product you choose, remember to always follow the mixing instructions on the bag for best results.**

Supplemental Light: You should not need extra lighting if you grow outdoors.

You WILL need some supplemental lighting to get the results you want.

Just placing the tower in a window is not enough for plants to grow well. If you choose to grow lettuce or other leafy greens in your tower, your lighting requirements will be minimal and can be satisfied by using inexpensive LED light tubes and fixtures available at any home improvement store. If you decide to tackle a bigger challenge and produce a flowering/fruited crop in your tower, then you may need to invest in some horticultural grade grow lights to achieve the best results. Always research your crop beforehand so you understand what your plants need.

Lighting Support Structure Suggestion:



Starting your Seedlings: Start your seeds in a 45 count, 1.5" x 1.5" rockwool cube sheet 2-3 weeks before you intend to put them into your grow tower. It is a good idea to start more seeds than will actually fit into your tower so you may pick the strongest most promising seedlings to transplant into the tower. From planting the seed until transplanting into your tower, you may just water the rockwool cubes and seeds with regular, unfertilized water. The cubes should be watered daily and kept consistently moist throughout the plant's life.



About a week after your seedlings emerge begin checking the bottoms of the cubes daily. Once you can see little white roots starting to poke out of the bottom of the cubes your seedlings are ready to go into your tower.

Prepare your tower by mixing the fertilizer of your choice according to the instructions on the fertilizer label and fill the base/reservoir of the tower with 2-3 gallons of this nutrient solution. Do NOT over fertilize, read the directions on the bottle.



Break your rockwool cube sheet into individual cubes with one plant per cube and simply push them down into the PVC elbows/plant sites on the grow tower. Be sure to push the cube down far enough that it is securely nestled in the elbow underneath the three holes that you drilled but be sure not to push them too far and lose them inside the tower. Plug in the tower and enjoy the fruits of your labor!

Maintenance and Feeding Instructions:

1. Monitor water levels and replace water, add nutrients to water before adding according to directions on container, as necessary. READ the directions, don't over fertilize!!!!
2. Recheck pH and adjust with proper solutions if necessary.
3. Watch leaves for any browning or yellowing. This will let you know if you have enough or too much nutrient in your water.
4. Visit <https://www.youtube.com/watch?v=Webb1cjen6s> or <https://www.nosoilsolutions.com/common-issues-hydroponic-gardeners-face/> for suggestions on troubleshooting growing issues.

Nutrient Suggestions: Choose a liquid hydroponic nutrient based on your preference, organic or not. If you are just doing leafy greens, choose a nutrient specific to growing leaves often labeled “grow”. If you are doing a plant with fruit, you will need to change the nutrient once the plant reaches a certain maturity (different with each type), often labeled “bloom”, when you wish for them to begin the process of developing fruit. You will need to hand pollinate the plants.



PH Testing – Use a test kit. A liquid test kit is preferable, but strips work as well. Use a solution to raise or lower the pH depending on results. Over fertilizing is often the cause of a wacky pH, but it can be the water you start with as well.



References

Books:

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by Derek Fell 2011 ISBN: 978-1-60529-083-6

Vertical Gardening for Beginners: How to Grow Organic Food at Home Without a Yard

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Foothill Hydroponics: <http://www.foothillhydroponics.com/>

General Hydroponics: <http://generalhydroponics.com/>

Hydroponics: <https://hydroponics.com/>

Institute of Simplified Hydroponics: <http://carbon.org/>

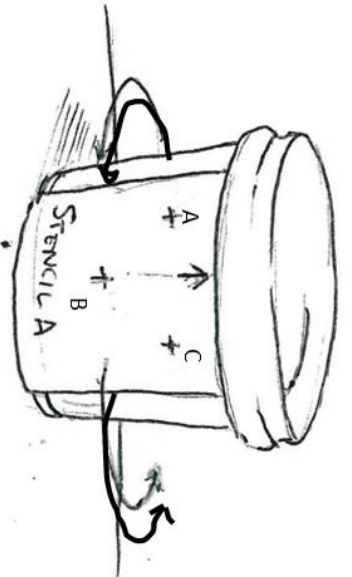
Simply Hydroponics and Organics: <http://www.simplyhydro.com/system.htm>

Uponics: <http://uonics.com/hydroponic-tower/>



A

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C

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Stencil A

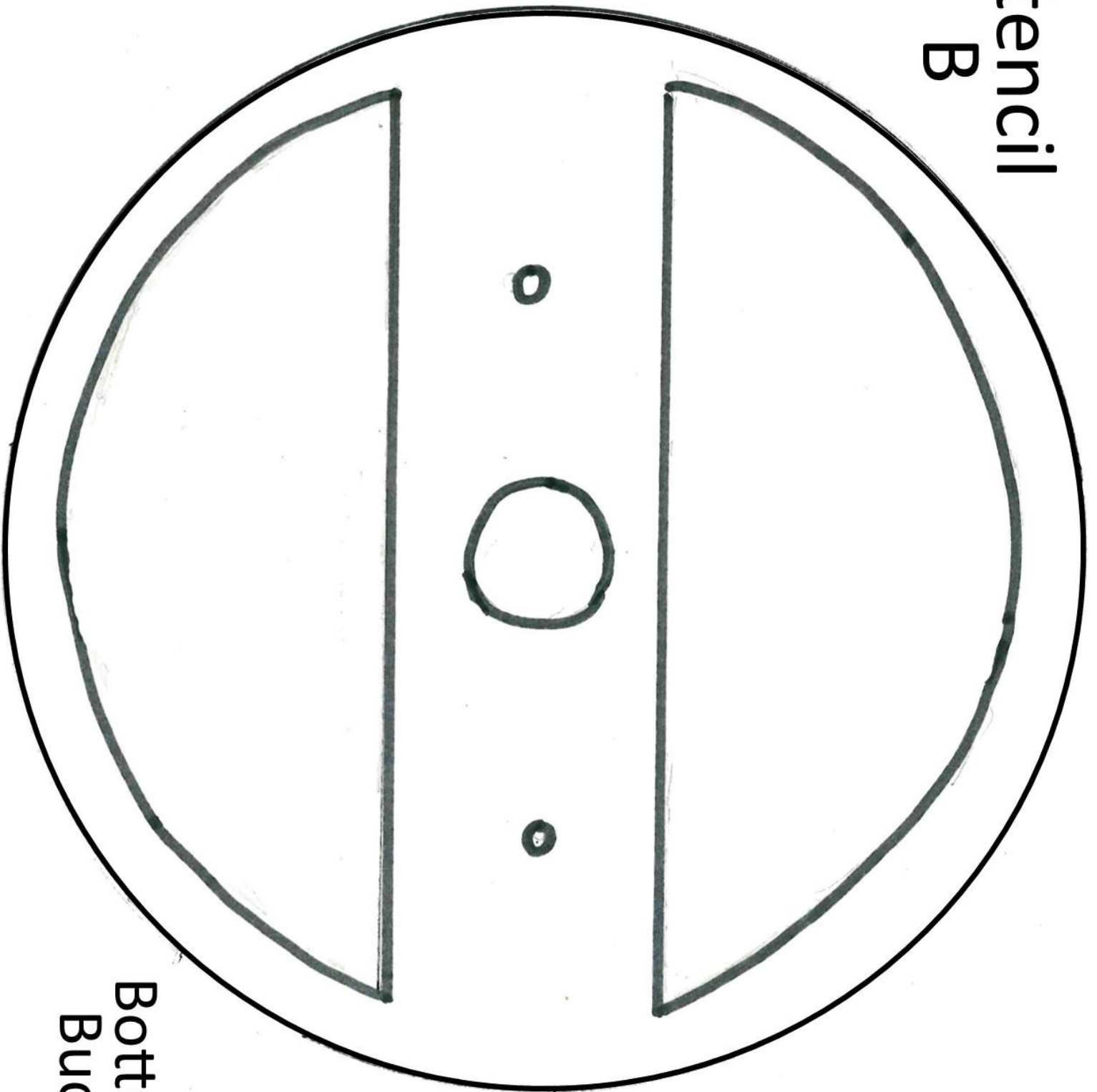
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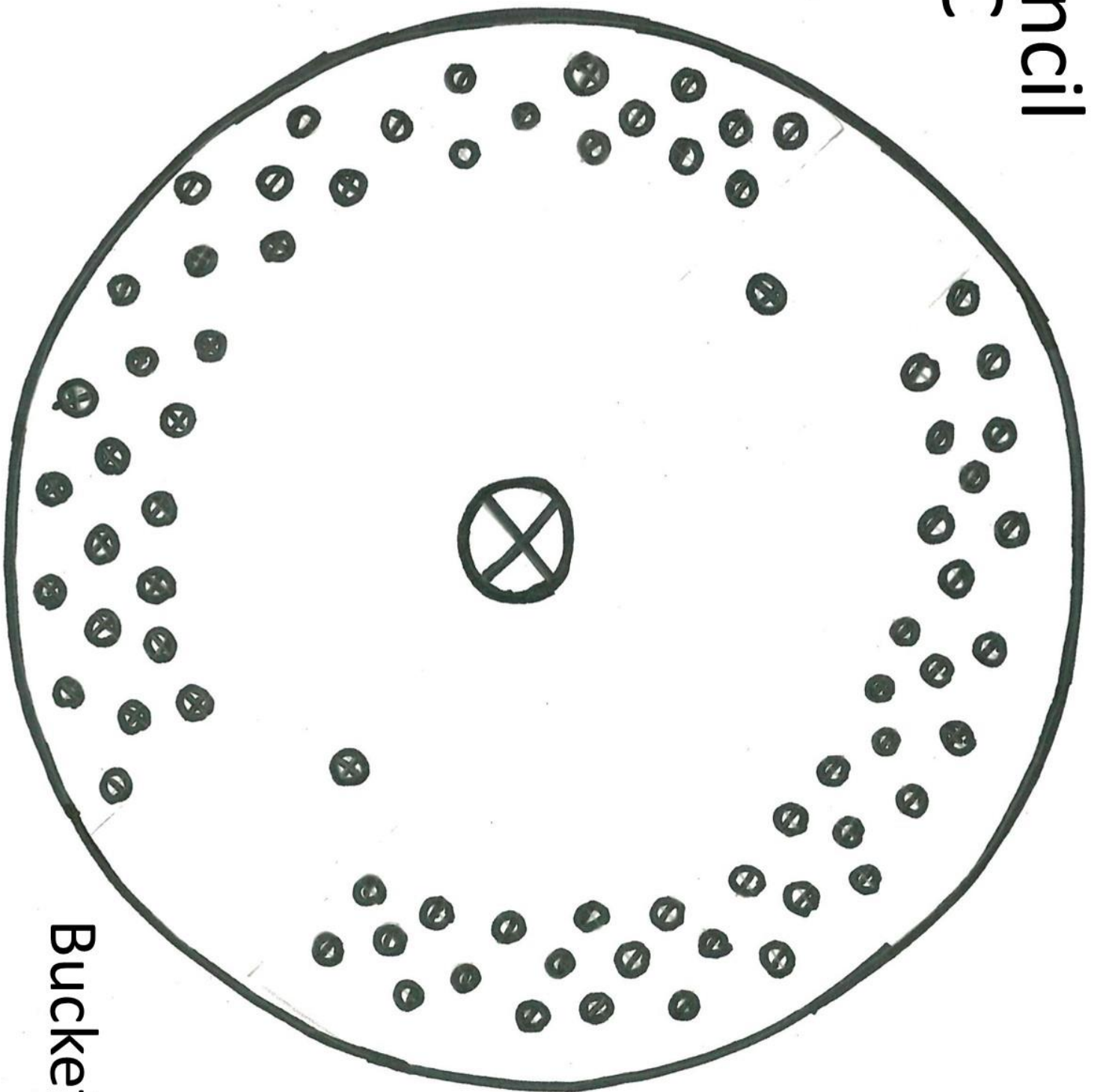
Bottom Fold on Dotted Line

Stencil B



Bottom of
Bucket

Stencil
C



Bucket Lid