

## Mini Hydroponic Grow Tower System

### Directions

The 'Do It Yourself' (DIY) Grow Tower Project is the brainchild of Alaskan entrepreneur Bernie Karl and his former greenhouse manager Jake Scott. It is much more than just an experiment with vertical hydroponics, it is a concept meant to spark the curiosity of the youth all over the country - To help sow the seeds that will yield the next generation of farmers and food suppliers in America.

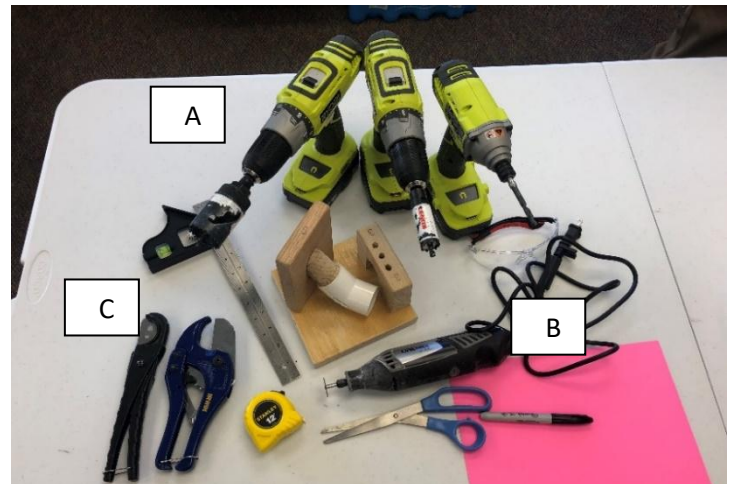
In order to cultivate a genuine passion for food production, one must first be introduced to it in a hands-on manner. That is the true purpose of the Lettuce Tower Project - An easy-to-build project that can get anyone involved in the construction and use of a hydroponic food production system.



The original system was a larger bucket tower that used 5-gallon buckets for the tower and a sump basin as the bottom and it had 72 plant sites. This mini version using a 2-gallon bucket and two 1 gallon buckets. This version has 10 plant sites.

#### Tools Needed:

- Drill (preferably cordless) (A)
- 1-5/8" Hole Saw Drill Bit
- Sharpie Marker
- Dremel Tool and Cutting Blades (B)
- PVC cutting tool (C)
- 7/8" Hole Saw Drill Bit
- 1/4" Drill Bit
- Heavy Duty Scissors
- Ruler/Tape Measure
- **Protective Safety Eyewear**



### Materials Needed:

- One 2-Gallon Bucket
- Two 1-Gallon Buckets
- One 2-Gallon Bucket Easy-Off Lid\*
- Two 1-Gallon Bucket Easy-Off Lids\*
- Three ft. length of 1/2" Pex Tubing (straight)
- Ten 1" 45° PVC Elbows
- 80-155 GPH Submersible Water Pump
- Four 1/4" x 1" Stainless Steel Hex Bolts
- Four 1/4" Stainless Steel Wing Nuts
- Four 2 Ft. LED Light Fixture
- Small funnel
- Hot Glue Gun and extra glue sticks
- 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.**



### Materials for Light Supporting Structure:

- 20 feet of 1" PVC Pipe – Four 25" lengths and Eight 16" lengths
- Eight 1" 90° PVC Three Way Elbow Sockets
- Zip Ties for attaching the lights
- One 6 spot surge protector power strip
- Three Prong Timer



## Prepare the Buckets and the Plant Sites

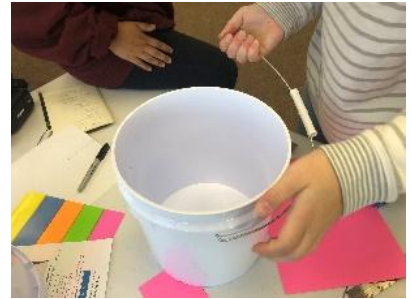
**Step 1:**

**Remove the handles from all buckets.**

**Step 2:**

**Set aside the 2 gallon bucket.**

**...Don't mark up this bucket! It doesn't get holes drilled in it.**



**Step 3:**

**Mark the remaining 2 gallon buckets for drilling with 5 evenly spaced dots, around 4" apart, in the middle of the bucket on the outside.**

**These dots will be where you drill the holes for the 1" elbows/plant sites.**



## Drill the Plant Sites

**Step 1:** Prepare the drill with the 1 5/8" Hole Saw.



**Step 2:** Cut out the plant sites on the 2 buckets using the 1-5/8" hole saw.



The plastic circle cut out will likely get caught in the drill bit. Use a screwdriver or pliers to remove it if needed.

## Drilling the Plant Sites

***Be sure to wear safety eyewear for all Power Tool steps, anyone nearby should wear safety eyewear also.***

- Step 1:** Use the 1/4" Hole Saw Drill Bit and a vise to hold the elbow or use a jig like the one below for drilling the holes. Drill three holes into the top of each PVC elbow to allow water to reach the plant roots. Be sure to drill the 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 and they are not right up to the bend in the elbow. The holes should be positioned so that they are completely inside the bucket when the elbow is inserted. ***Clear away any plastic debris.***



- Step 2:** Insert each elbow into each of the holes on buckets #1 and #2 . ***It will be a tight fit so be forceful.***



## Gluing the Elbows

- Step 1:** Now it's time to seal the elbows. Plug in the glue gun and have plenty of extra glue sticks handy.
- Step 2:** Using the glue gun, create a seal around each elbow to the bucket. Be sure to create an even seal around bottom and sides of the elbows. Be sure there is proper ventilation for fumes. Remove any hairy glue strings left after you finish.



## Prepare the Bottoms of the 1 Gallon Buckets

*Be sure to wear safety eyewear for all Power Tool steps, anyone nearby should wear safety eyewear also.*

**Step 1:** Prepare the Dremel Tools with a cutting blade.



**Step 2:** Mark the bottom of the 1 gallon buckets using the Stencil A (found at the end of the instructions). 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.

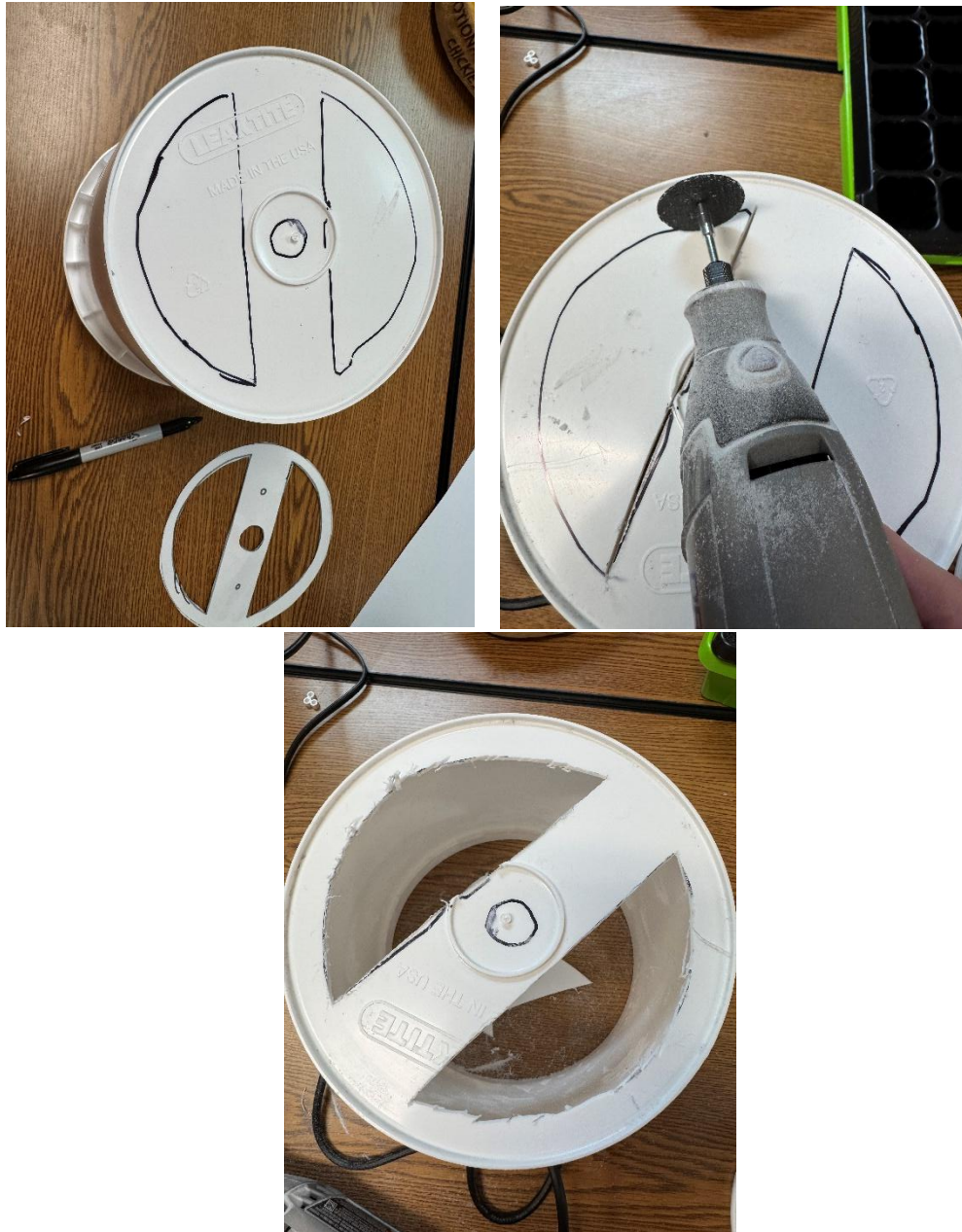
**Step 3:** Look for the circles in the center of the bucket bottoms. Flatten any dimples in the plastic in the middle of the circle using the Dremel tool.



**Step 4:** Put the 7/8" Drill Bit on the Drill and drill a hole in the center of the bucket bottom. The plastic circle cut out will get caught in the drill bit. Use a screwdriver or pliers to remove this happens.



**Step 5:** Using the Dremel, cut away two large sections leaving just a strip of plastic where the water line and bolt holes are situated.



**Repeat Steps 3-5 for the 1-gallon bucket bottoms including the top one which doesn't have plant sites.**

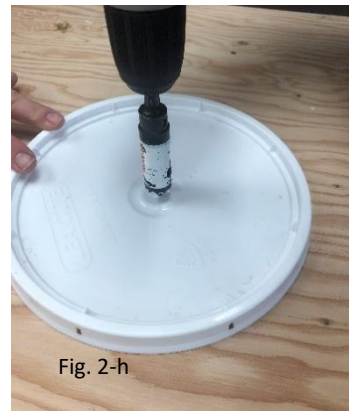
## Prepare the Lids of the Buckets

*Be sure to wear safety eyewear for all Power Tool steps.*

**Step 1:** Set one 1 gallon lid aside, this is the top lid and will not have holes.

**Step 2:** Mark the remaining 1-gallon and two gallon bucket lids using Stencil B.

**Step 3:** 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 bucket lids. Be sure to do this on a scrap piece of wood to protect your table.



**Step 4:** Remove the hole saw and put the 1/4" drill bit on the drill.

**Step 5:** Cut out Stencil B. Using Stencil B drill the drainage holes through the paper on the bucket lids using the 1/4" drill bit. Drill both the 1 gallon lid and the two gallon lids.



**Step 6:** Lay the 1-gallon lid on top of the bottom of the 1 gallon bucket. Line up the middle hole. Look for the band on the bottom of the bucket. Drill the first of the two holes through the band on the bucket and the lid. Put the bolt in and add the wing nut and finger tighten. Add additional washers if desired.



**Step 7:** Prepare the 2 gallon lid. Use the 1 5/8" hole saw to cut a hole in the 2-gallon lid for the electric cord for the pump.



**Step 8:** Attach the one gallon bucket to the 2 gallon lid the same way you did in step 6.

## Set up the Water Line and Assemble the Tower

- Step 1:** Connect the adapter that comes with the pump to one end of the 3 ft length of Pex tubing. Soaking the end in boiling water sometimes makes it easier to attach. Attach the hose fitting to pump and place the pump in the bottom of the 2-gallon bucket.



- Step 3:** Slide the tower bottom lid and bucket assembly down the pipe and feed the pump cord through the hole you drilled for it.



- Step 4:** Slide the rest of your buckets and firmly snap each lid to the top of the next bucket. Trim pipe with the PVC cutter to be 1 inch lower than the top of the bucket. Add a trimmed down small funnel to the top bucket on the pipe to help distribute the water evenly to the sides. You might need to add a rubber band to keep it tight. Put on the top bucket lid.



## Building the Light Structure

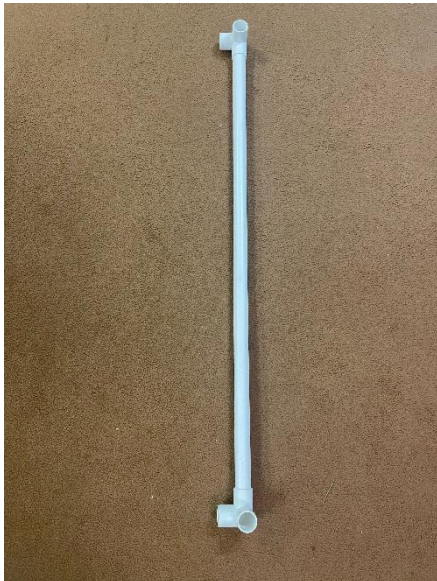
**Step 1:** Cut four 25" lengths of 1" PVC pipe using the PVC cutter.

**Step 2:** Cut eight 16" lengths of 1" PVC pipe

**Step 3:** Count out 8 three way PVC elbows.



**Step 4:** Attach 2 elbows to each of the 25" PVC Pipes.



**Step 5:** Add a 16" pipe to one of the 25" pipes. Connect to another 4 foot pipe.



**Step 6:** Continue connecting all the pipes until your structure looks like this:



**Step 7:** Attach the lights to the 25" pipes with zip ties and the light holders that come with the lights. You can also screw them directly into the PVC with the screws that come with the lights.



## Growing Plants in Your Tower

**So you have built a brand new vertical grow tower...  
*Now what?***

**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 Bucket 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 lettuce, 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. We recommend using a hydroponic fertilizer. Some fertilizer brands such as DynaGrow has proved itself to work well in the tower. 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 in a 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 package for the best results.**

**Light:** You WILL need 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 kind of lights your plants need.

## Starting Your Seedlings

**Choose Your Grow Media:** The grow tower requires plants to be grown in an inert media that provides support for the stem and roots but gives no nutrients to the plants. Soil does not work because it will wash away and clog the pump. The two types of media that work best in the tower are Rockwool (1 ½”cubes) or Grow Plugs such as Rapid Rooters or Root Riot. Media comes with a hole in the top for placing your seeds. It is best to wash the rock wool and the rooters before using.



### Starting Seedlings:



Start your seeds in six pack containers and have them under lights on a shelf for 2-3 weeks before you intend to put them into your grow tower. It is a good idea to start more seedlings than will actually fit into your tower so you may pick the strongest most promising seedlings to transplant into the tower.

Place one to two seeds in each cube or plug. Plants should be grown on a shelf with lights at most 3” from the container they are grown in.



### Watering the Seedlings:

From planting the seed until transplanting into your tower, you should water the media and seeds with regular, unfertilized water. Keep water in the tray and use a spray bottle to spritz the top daily. The cubes should be kept consistently moist throughout the germination process.

### Are they ready?

About a week after your seedlings emerge, watch for the second set of leaves to start growing. Begin checking the cubes daily. Once that second set is fully out, your seedlings are ready to go into your tower.

## Putting Plants into the Tower

**Prepare your tower:** Fill the base of the tower to 4-5 inches below the top of the bucket.  
Mix in the nutrients according to the instructions on the label.

If you are using Dyna Grow Nutrients:

1. When you add water to the tower initially, add 2 tsp of fertilizer per gallon.
2. When you add water as the tower is going, reduce it to 1 tsp/gallon.
3. If you have too much algae in the water and it gets very green, replace all the water and treat it as you would as if you were starting the tower again.



### **Add the Plants:**

Start the plants under a grow light in the hydroponic media of your choice, rockwool or grow plugs. When the plants have their second set of leaves, it's time to put them in the system.

If you use rockwool sheets, break your rockwool into individual cubes. Nestle the plant cube or plug into a PVC elbow and gently push it down into the elbow so that it is securely nestled in the elbow underneath the three holes. Be sure not to push them too far and lose them inside the tower.

### **Lights:**

Turn on the lights. Keep the lights on a timer. 12 hours on and 12 hours off is the best schedule for leafy plants. Do not plug the pump into the timer. The pump should be on all the time and plugged in separately.

### **Harvesting Your Plants:**

Plants do not need to be harvested all at once. You can use the leaves as they grow. Pick lettuce leaves from the outside to encourage continuing growth. Do not pick from the middle of lettuce. Herbs should be picked so that you don't remove all the leaves. The plants will sprout new leaves. Always remove any flowers on herbs.



## Grow Tower Care and Cleaning Instructions

1. Keep the lights on a timer. 12 hours on and 12 hours off is the best schedule for leafy plants. Do not plug the pump into the timer.
2. Monitor water levels and add water when water is 2-3 inches above the pump. When adding more water, add nutrients to water.
3. READ the directions on your nutrients, don't over fertilize!!!! Reduce the nutrients on water additions after the initial starting of the system to prevent nutrient buildup and overload. Generally, 2 teaspoons/gallon start system, then when adding water reduce to 1 teaspoon/gallon. This will prevent salt from building up in your water.
4. Watch leaves for any browning or yellowing. This will let you know if you have enough or too much nutrient in your water.
5. Check the pump if the water sounds are different or reduced. Unscrew the PVC center pipe from the pump. Wash off the plant material and put the pump back together and put back on the PVC pipe and back into the tower. The pump should be on all the time and plugged in separately from the lights



**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”. Look for something with NPK numbers similar to 7-9-5 as a general fertilizer.

If you are growing a plant with fruit (such as a tomato), you will need to change the nutrient once the plant has started to put out flower buds (different with each type). Look for a nutrient labeled “bloom”. You will need to hand-pollinate the plants.



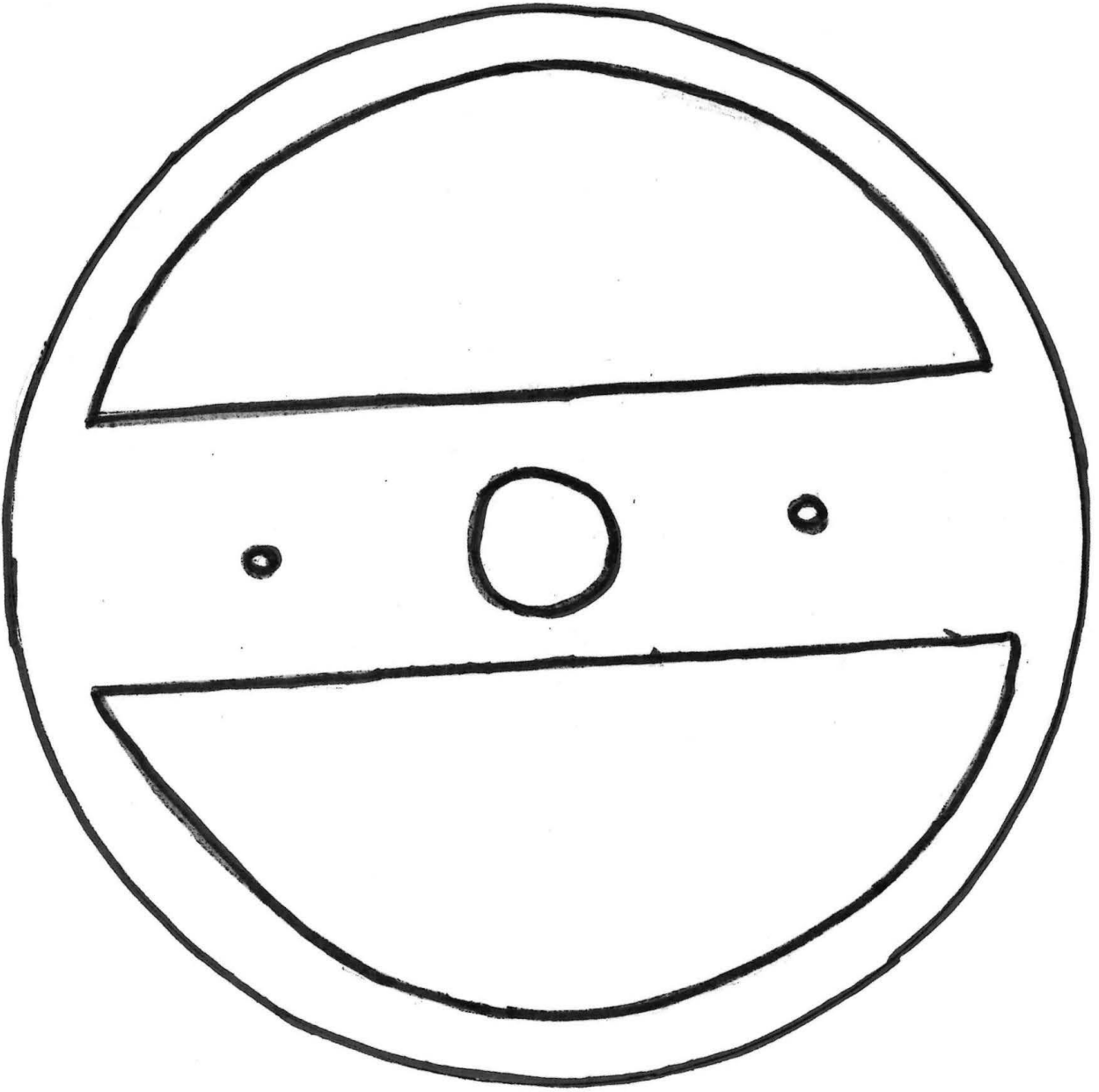
### Algae and Pests

Algae growth is normal in a grow tower. It is not toxic or dangerous to the edibility of your plants. Fungus gnats which love algae can be a problem. Here is an article that might help you if you have an algae issue.

<https://plantprovider.com/managing-algae-in-hydroponic-systems-step-by-step/>

Aphids can get on a tower when you introduce houseplants bought at a store or nursery. Use non-toxic sprays to manage like NEEM oil or Safer Insect Soap spray.

# Stencil A



# Stencil B

