Small 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. This smaller version using a 5 gallon bucket and three 2 gallon buckets was designed by the Upward Bound Program at the University of Alaska Fairbanks and further modified by the Silent Springs FFA chapter.

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
• Copies of the Stencils (end of directions)
• 1/4" Drill Bit
• Heavy Duty Scissors
• Ruler/Tape Measure
• Protective Safety Eyewear for all!
Materials Needed:
- Three 2-Gallon Buckets
- One 5-Gallon Bucket
- One 5 Gallon Bucket Easy-Off Lid*
- Three 2-Gallon Bucket Easy-Off Lids*
- Four Foot length of 1/2" PVC straight PEX tubing
- Sixteen 1" 45° PVC Elbows
- 158-200 GPH Submersible Water Pump
- Six 1/4" x 1" Stainless Steel Hex Bolts
- Six 1/4" Stainless Steel Wing Nuts and washers
- Four 2 Ft. LED Light Fixture
- Hot Glue Gun and extra glue sticks
- 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.

Materials for Light Supporting Structure:
- 1" PVC Pipe – 4 4’lengths and Eight 21 ½” lengths
- Eight 1" 90° PVC Three Way Elbow Sockets
- 2 2’x2’ pieces of plywood for top and bottom (Optional)
- Zip Ties or Small Screws for attaching the lights
- One 6 spot surge protector power strip
- Three Prong Outlet Timer
Prepare the Buckets and the Plant Sites

Step 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!****

Step 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 fold up the dotted line on the template and 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)
Be sure to wear safety eyewear for all Power Tool steps, anyone nearby should wear safety eyewear also.

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 get caught in the drill bit. Use a screwdriver or pliers to remove it if needed.
Drilling and Installing the Elbows

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

Step 1: Use a vise to hold the elbow or use a jig like the one below for drilling the holes. Using the 1/4\" Drill Bit, 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 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.

Step 2: After cleaning the plastic debris away, insert each elbow into each of the holes for the plant sites drilled into the buckets. It will be a tight fit so be forceful.
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.
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 2 gallon buckets using the Stencil B (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: 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 it if needed.

(Step 4: On Back)
Step 4: Using the Dremel, cut away two large sections leaving just a strip of plastic where the water line and bolt holes are situated.

Be sure to cut the bottom out of the top 2 gallon bucket that you put aside in this same way.
Prepare the Lids of the 2 Gallon Buckets

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

### 2 Gallon Lids

**Step 1:** Set one 2 gallon lid aside, this is the top lid and will not have holes.

**Step 2:** Mark two of the 2 gallon bucket lids using Stencil C.

**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 2 bucket lids.

**Step 4:** Remove the hole saw and put the ¼” 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.

**Step 5 on the Back**
Step 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 or regular nuts and washers (if desired).
Prepare the Lid of the 5 Gallon Bucket

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

Step 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.

Step 2: Drill the center hole with the 7/8” hole saw through both the lid and the 2 gallon bucket bottom.

Step 3: On Back
Step 3: Create two symmetrical holes to bolt the lids to the buckets above them in the tower. Clear away all plastic debris and bolt each lid to the bottom the 2 gallon 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.
Set up the Water Line and Assemble the Tower

Step 1  Connect the threaded male PVC adapter that comes with the pump to one end of the 4ft length of PVC Pex tubing pipe. You can use the red washers that come in the pump package to give it a tight fit. If it is still loose, add some marine glue and let it dry before finishing assembly.

Step 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.

Step 3  Stack your buckets in the order that they are numbered and firmly snap each lid to the top of the next bucket. Add a funnel to the top bucket on the pipe to help distribute the water evenly to the sides. Trim pipe with the PVC cutter to be flush with the top of the funnel. Put on the top bucket lid.
Building the Light Structure

Step 1: Cut four 4 foot lengths of 1” PVC pipe using the PVC cutter.

Step 2: Cut eight 2 foot lengths of 1” PVC pipe.

Step 3: Count out 8 three way PVC elbows.

Step 4: Attach 2 elbows to each of the four foot PVC Pipes.

Step 5-7 on the Back
Step 5: Add a 2 ft pipe to one of the 4ft 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 4 foot 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.
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 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 container for 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/fruiting 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.
Choose Your Media: The two types of media that work best in the tower are Rockwool or Rapid Rooter peat plugs. Both come with a hole in the top for placing your seeds. 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. If you don’t have a shelf, grow the plants on a plate on the top of the tower.

Watering the Seedlings: From planting the seed until transplanting into your tower, you may just water the media and seeds with regular, unfertilized water. Spray bottles are the best to assure you don’t over water. The cubes should be watered daily and kept consistently moist throughout the germination process.

Are they ready? 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. This often occurs when the secondary leaves emerge.
Prepare your tower: Mix the fertilizer of your choice according to the instructions on
the fertilizer label and fill the base/reservoir of the tower with 3-4
gallons of this nutrient solution. Do NOT over fertilize, read the
directions on the bottle.

If you are using Dyna Grow Fertilizer:
1. When you add water to the tower initially, add 2-3 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: If using rockwool, break your rockwool cube sheet into individual
cubes with one plant per cube. Nestle the plant 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 that you drilled.
Be sure not to push them too far and lose them inside the tower.

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. It 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.
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!!!!!! It’s a good idea to reduce the fertilizer on water additions after the initial starting of the system to prevent nutrient buildup and overload.

2. Recheck pH and adjust with proper solutions if necessary. Watch leaves for any browning or yellowing. This will let you know if you have enough or too much nutrient in your water.


**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.

**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.


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.