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Propagation System Manual

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Table of Contents

Introduction:

Contained in this manual you will find the required materials, assembly instructions, operation procedures and safety protocols to construct, run and maintain a hydroponic propagation system.

Hydroponics is a method of growing many terrestrial plants without the use of soil. Soil is not essential to plant growth; therefore it is possible to grow plants hydroponically by controlling the environment conditions and providing the optimal amount of nutrients, water, and light in order for the plants to grow. Seeds are planted in hydroponic growth media; an artificial soil that supports root growth and development while holding water and nutrients for root absorption. This growth media can vary between tiny micro plastic fibers, gravel, water/ nutrient solution, perlite, vermiculite, and coconut fiber. Before plants can thrive in hydroponic growth media they must begin in the Propagation System.

The Propagation System is designed to provide an environment for seeds to germinate with optimal conditions for seedling growth. The purpose of the Propagator is to create an environment that is suitable for seedlings to develop a strong root system and uprooted stem so they can be transplanted into a new system where they are able to fully develop and be harvested. This procedure introduces plants, vegetables, and fruits to a new system of hydroponic growth that is controlled, productive, uncontaminated, and resource efficient.

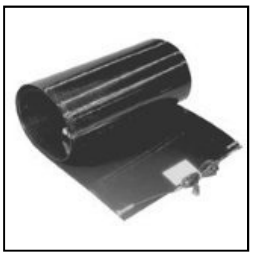
This manual has a dual objective: first, to illustrate the steps required to construct a hydroponic propagation system; and second, to give the reader a clear outline on what is needed to run and operate a successful system.

Materials:

To construct the Propagation System several materials will be needed, along with tools to put these materials together. The materials necessary to assemble the Propagation system include:

a. Metal frame made of 1 inch tubular square steel (16 gauge steel) with about a 45″ long, 44″ wide, and 23″ tall dimensions:

b. A wooden board with 45″ long by 44″ wide dimensions to support the Propagation trays. Or any size that fits perfectly on top of the metal frame.
c. A 2″ thick and 6″ high board by 44″ to place as a backboard on the large wooden board to support Propagation trays and tubing.
d. A roll of black plastic material to cover the wooden board.
e. Two flat heating pads: Olson Products Inc. Low Watt Propagation Mats.



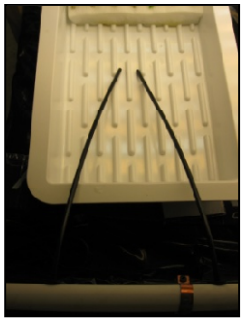
f. Three drainage growing trays: approximately 45″long by 12.5″ wide:

g. Three fill / drain filling adaptors to place in the end of drainage trays.

h. Two (h1) ¾" plumbing tubes with (h2) two end caps and (h3) connector:

(h1)  (h2)  (h3) 

i. Six drainage tubes:



j. Six rubber grommets 7/16" :

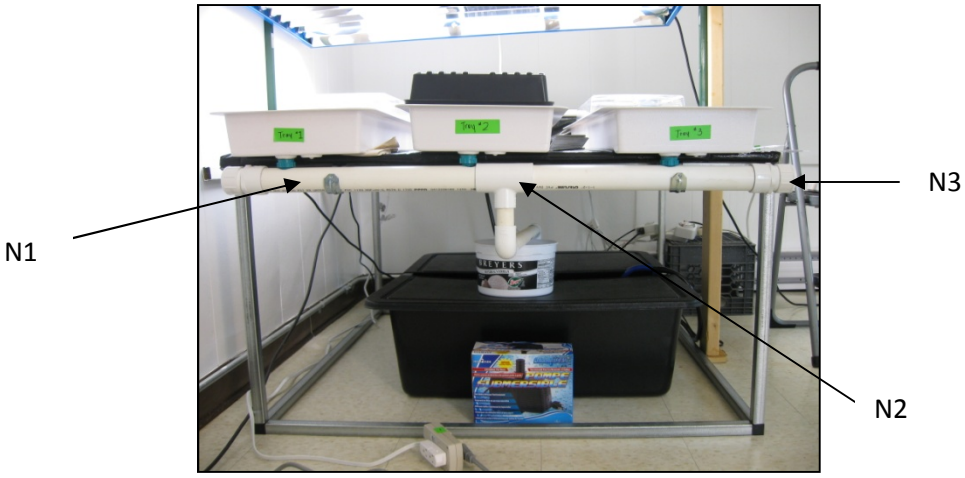
k. Two ½" sheet metal screws, with fitting screws:

 Or 

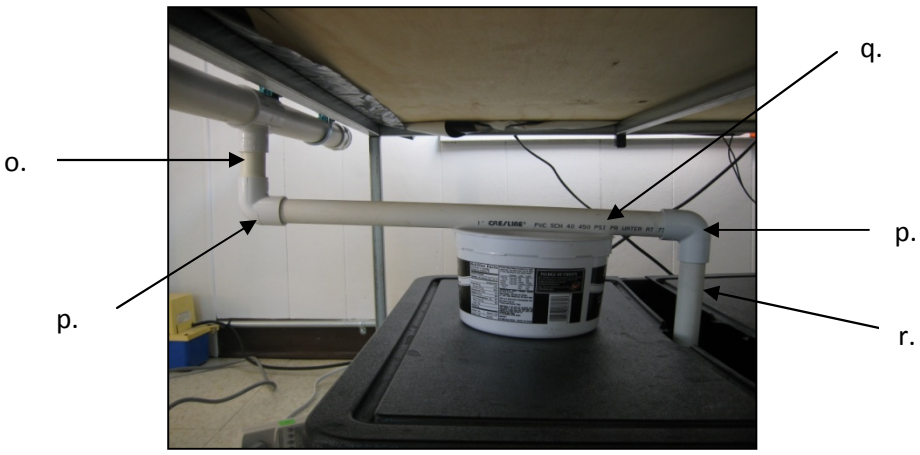
l. Power Trip T5 Commercial Grade Lights (4 foot / 8 tube unit with bulbs).

m. String and hook to suspend light system.

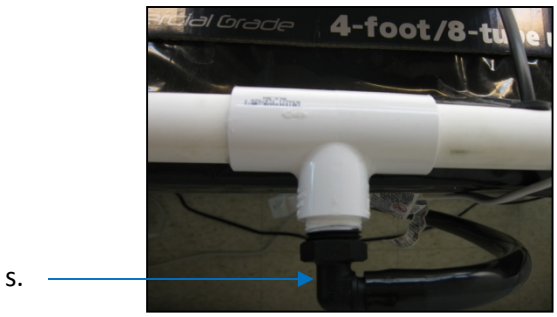
n. Two (n1) 1 ½" plumbing tube to make 43" long with (n2) Connector piece and (n3) end caps:



o. One 1" plumbing tube about 4" long
p. Two 1" elbow connector
q. One 1" plumbing tube about 22" long
r. One 1" plumbing tube about 10" long

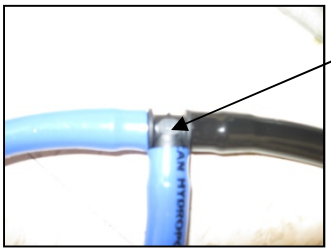


s. Elbow connector from ½" connector plumbing tube to pump hose.



t. At least 10 feet of hose with ½" diameter tube to pump water out of reservoir.

u. Three way connector for water pump tubing:



v. ½" isolation gauge valve:

w. About 30" long 29" wide water basin with two top cover, should be able to hold about 40 gallons.

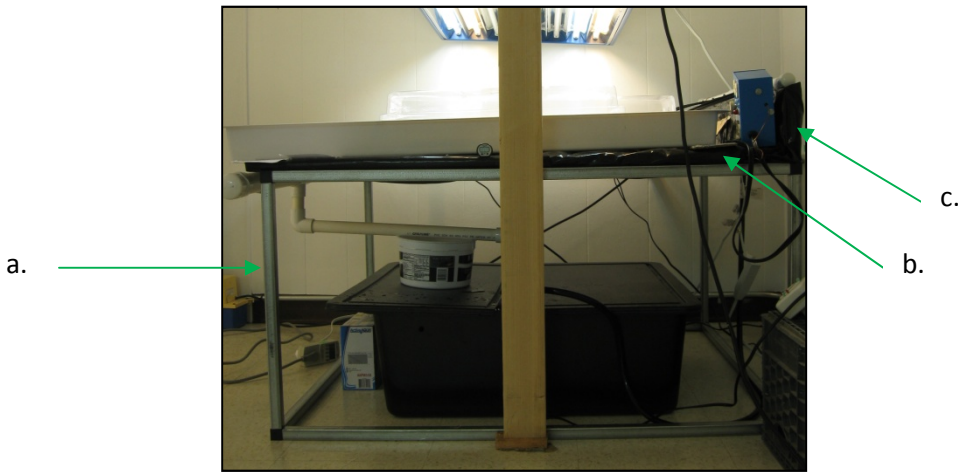
x. Submersible Pump (Hydrofarm)

y. Two sheet metal hooks:

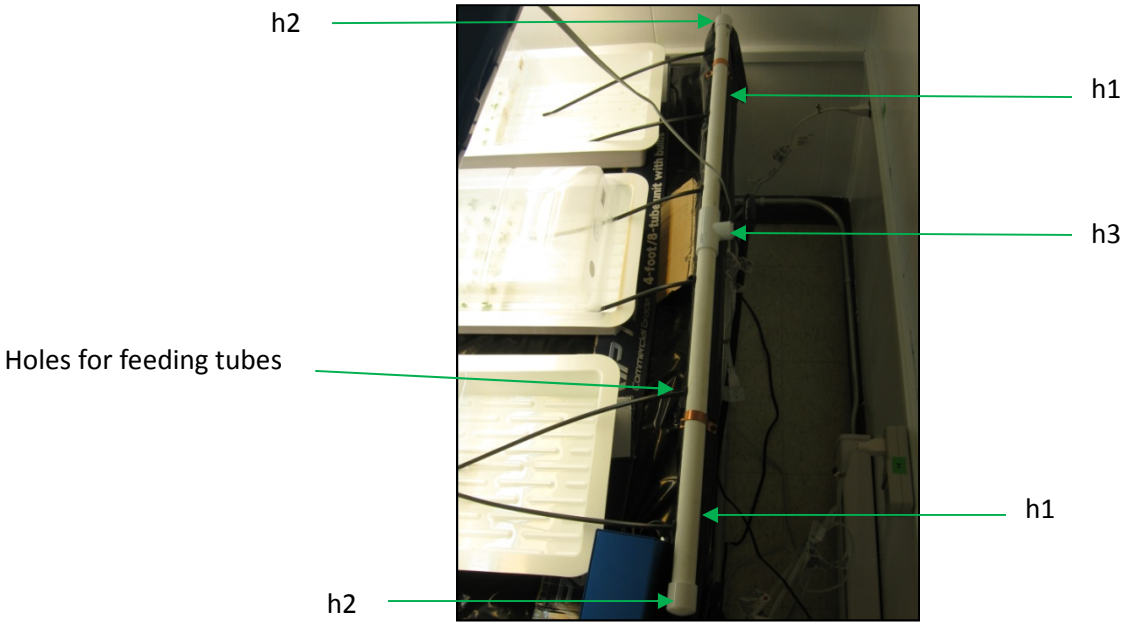
Instructions:

The materials listed above to assemble the Propagation System can be found at stores such as Home Depot or any Hydroponic store nearby. Materials do not have to be exactly as shown above, depending on what size system is preferred. Use these materials and size dimensions as a guideline when assembling the system. Here are the steps to the construction of the Propagation System:

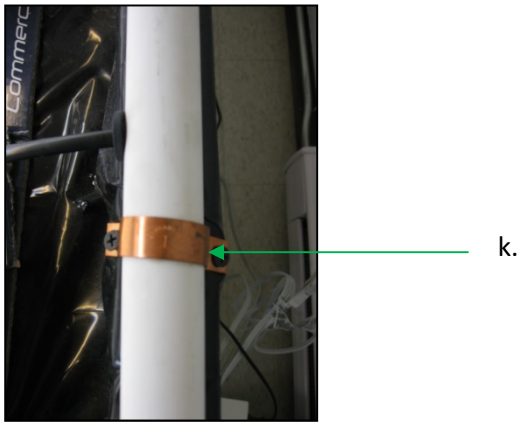
1. Place two heating pads centered on (b.) 45″ x 44″ wooden board and wrap board and heating pads completely with black plastic wrap and with a slit for cords to plug into outlet.
2. Also wrap (c.) 2″ thick and 6″ high board by 44″ with plastic wrap. This wrap can be sealed with staples to keep in place.
3. Place 45″ x 44″ wrapped board on (a.) steel metal frame. Then place (c.) 2″ thick and 6″ high board by 44″ so that it is standing up on the top end of the base, serving as a headboard. To hold this head board in place, screw in the bottom with screws so that it is stable.



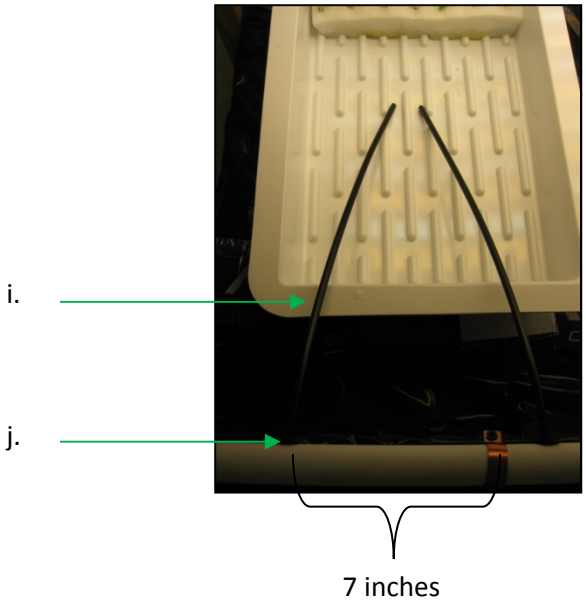
4. Drill a hole in the center of one end of each drainage tray that will fit the desired the (g) fill / drain filling adaptor. Place (g) fill / drain filling adaptor in drilled hole. Use cocking glue to secure in place and prevent any leakage. The cocking glue must wait to dry 24 hours before testing any leaks. Once tested and no leaks occur, trays are ready to run through the feeding cycle.
5. Place (h2) end caps on one side of each (h1) ¾″ plumbing tubes. Connect these two tubes with (h3) three-way connector piece. This structure serves as the plumbing tube that holds the feeding tubes to feed water into the trays. Place on top of (c.) 2″ thick and 6″ high board by 44″ board.



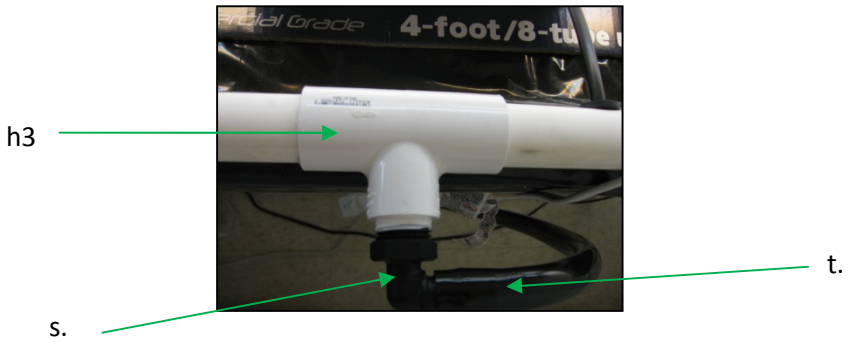
6. Drill six holes, each 7" apart with 1/8" diameter inside and ¼" diameter outside. The holes should be large enough to secure rubber grommet in place to hold feeding tubes.
7. Secure piping into place with two (k.) sheet metal screws at two ends of piping.



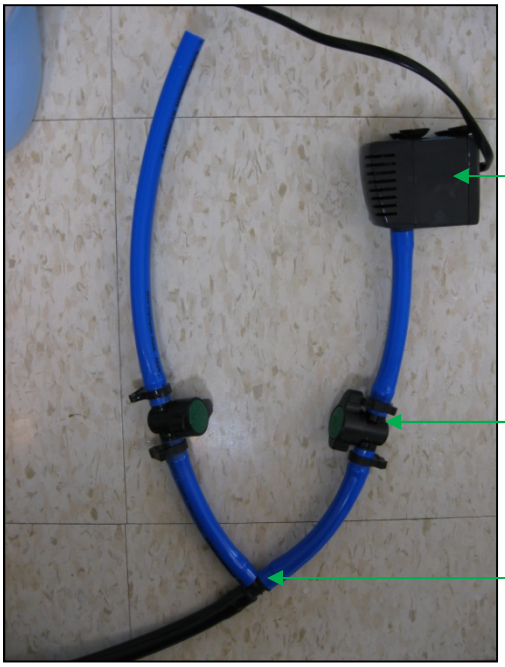
8. Place (j.) rubber grommets in each hole and then fit feeding tube into grommet and plumbing tube so that water can drain out.



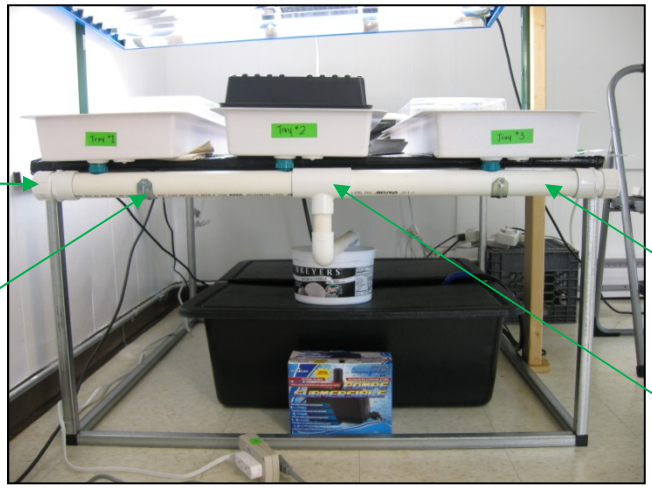
9. Attach (s.) elbow connector between (h3) three way ½" plumbing tube and enough length of (t.) hose to reach from tubing to water reservoir.



10. Cut hose once it is long enough to reach the water reservoir when attached to system. Insert a (u.) three-way connector into hose and attach two short (about 10") of hose to other openings in connector.
11. Attach (v.) ½" isolation gauge valve to two ends of hose.
12. Attach another two cut pieces of hose, about 20" and 15" long to the two ½" isolation gauge valves. The 20" hose is to drain water back into the water reservoir. Attach the 15" hose to (x.) the submersible pump.

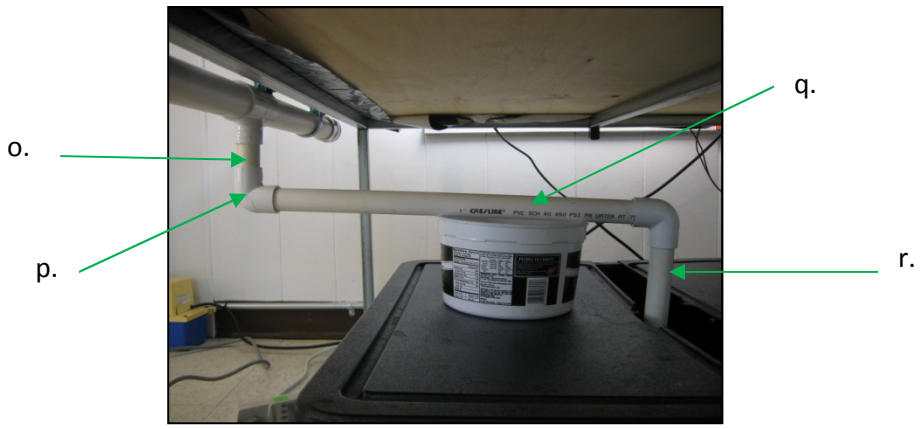


13. Place (w.) water basin under steel frame. Place hose and pump in water basin so water is able to be pumped out to the rest of the system.
14. Attach two (n1) 1 ½" plumbing tube to make 43" long with (n2) Connector piece and place two (n3) end caps on either side. Drill holes in 1 ½" tubing 15" and 14" apart large enough for drains to fit and drain water into without spill.
15. Attach tubing to wooden base board with two (y.) sheet metal hooks.

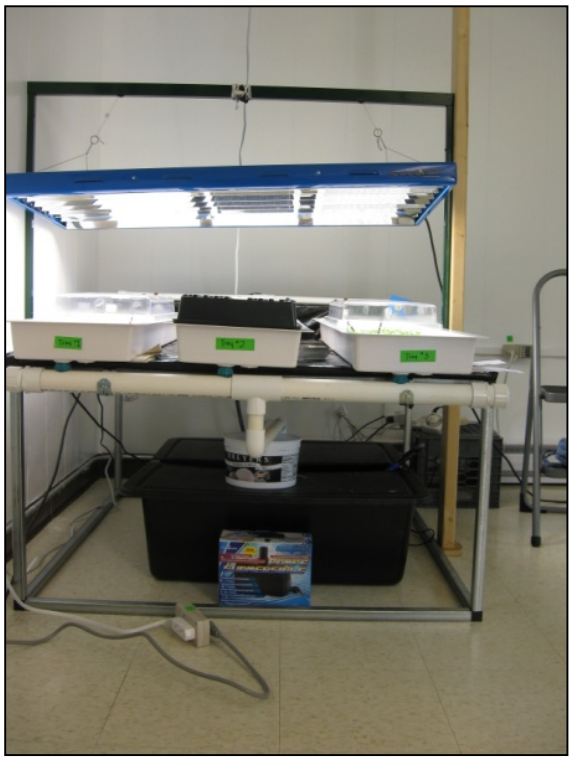


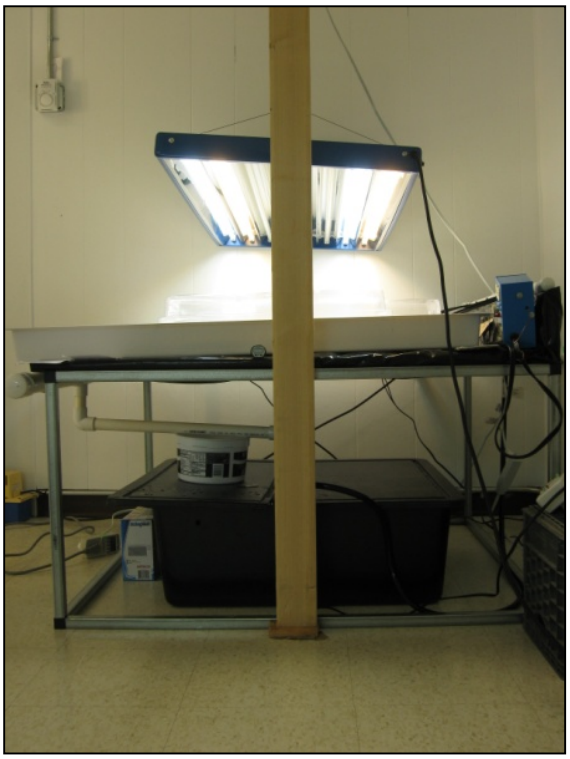
16. Connect (o.) 1" plumbing tube (4" long) to (n2) 1 ½" three-way connecting piece.
17. Attach (p.) 1" elbow connector to 1" tube. Then attach another (q.) 1" plumbing tube, about 22" long to elbow.

18. Attach another (p.) 1″ elbow tube to (q.) 1″ tubing. Attach (r.)1″ tube, about 10″ long, to elbow for water drainage. This should be open side into the water basin.



19. Tubing may need support; any sturdy material that can hold up tubing at an elevated level may be placed under tubing.
20. Hang Power Strip lights with string at least 14″ from trays on propagation base.
21. Final product of Propagation System should look similar to this:





Operation:

Once the Propagation System set up is complete, it is ready to run. The steps how to efficiently operate and maintain a constant controlled environment in the Propagation System is as follows:

I. Water Reservoir

1. The first step before planting the seeds is to fix the water bath to the correct amount of nutrients and pH level.
2. To germinate, seeds require a moist and dark environment. Once germinated, the nutrient bath provides them with the essential nutrients for them to grow. Different plants, vegetable, and fruits have different nutrient ranges that they grow best in. The first two weeks, it is not necessary to bath them in this range of nutrient. During the propagation period seeds and germinating plants develop in a system with a nutrient bath at 800 +/- 50 ppm (parts per million).
3. To fix the water to this nutrient level of 800 +/- 50 ppm a large graduated cylinder is necessary to first fix the nutrient bath. Start by adding 200 mL of Future Growing Tower Tonic Mix A. Then add 200 mL of Future Growing Tower Tonic Mix B.
    i. <u>Whenever adding nutrients to the water bath always add equal amounts of both nutrient mixes.</u>
    ii. Also, it is important to add each nutrient mix separately. Do not mix both nutrient solutions before adding to the water reservoir because a precipitate will form. It is important to be cautious of how much you are adding while following the procedure.
4. Mix well with a stirring stick so that nutrient solutions have fully been mixed in water bath.
5. Use the Combo Waterproof pH/EC/TDS/Temperature Tester to measure the ppm of the water bath. This can be done by using a small measuring cup to sample water from the reservoir. Place the Combo Tester in the water sample and a reading of the water's temperature, pH, and ppm should appear.
6. If the ppm is too low more nutrients, equal amounts of Mix A and Mix B, must be added. If the ppm is too high, water must be taken out of the reservoir. Drain enough water out of the reservoir so that the amount of water added back from whatever water source available will lower the ppm level. When first fixing the nutrient level of the water bath a significant amount of nutrients is necessary for the 25 gallon reservoir. Be aware and record how much nutrients are being added. Record the start

and end readings, along with the total amount of nutrients added to meet the optimal level.

7. An adequate pH level for germinating and first two weeks of plant growth ranges between 5.8 and 6.2. To fix the water to lie between these ranges, add either the pH up or pH down solution. If the pH is below 5.8 add pH Up to the water bath. If the pH is above 6.2 add pH Down to the water bath.
8. When adding pH up or pH Down to the water bath use a graduated cylinder to measure out a precise amount of solution. When fixing the water reservoir a significant amount of pH up or pH down must be added, so be aware and record how much solution is being added.
9. Once the nutrient level lies within 800 +/- 50 ppm and the pH level lies between 5.8 and 6.2 the water reservoir is ready to feed and run. Always record the reading of these two measurements and the amount of nutrients, pH solutions, and water added to maintain this optimal level of nutrient bath.

II. Planting

1. Place Sure-to-Grow 1.5" cubes in Propagator trays. Place ten more cubes in tray than desired amount of plants to germinate and further harvest in case several plants are not able to germinate or die off.
2. Once cubes are in place, plant two to three seeds of each desired plant in each cube. This way it increases the chances of each cube to have at least one seed germinate. This will not hinder results of plant germination or growth.

III. First 48 Hours

1. Once seeds are planted, place a black germinating tray over seeds. This way seeds are given a dark and humid environment so that they are able to sprout earlier.
2. Do not turn the lights on until the first seeds have sprouted. Once the first seeds have sprouted which should be within 48 hours, sometimes another day or two is necessary, the dark germinating tray can be removed and half of the lights can be turned on. Too much light intensity on the germinating seeds for a long period of time can cause algae growth. By only turning on half of the lights at first algae growth is minimized.

IV. Duration in Propagation System

1. After a majority of the seeds have sprouted, turn on all of the lights.
2. Lights, feed and heat should all be on timers. Feed timer should be set to on three times a day, for one hour each time. Heat timer should be set on for 6 hours and off for 18 hours. Light timer, when turned on, should be set on for 18 hours a day and off for 6 hours.

    i. The timing of the feed, heat, and light is very important. These three factors are vital to the process of germinating seeds and their progress in the Propagation System.
3. Once timers are set, the system can run on its own. For the duration of the plants growth in the Propagation System, the water reservoir must be checked daily and fixed if it does not meet the plants optimal conditions for growth.
4. Water level must be checked every day. Mark on a dip stick the initial water level. When checking every day, make sure the water level does not fall below an inch of the initial fill line. If it does, which it will after a couple days, add water to fill line. This will change the ppm and pH level so do this before any other testing.
5. To check the water reservoirs use the Combo Tester to test the ppm and pH level. Test the ppm level first in case water must be added or taken away which would in turn change the pH.
6. To adjust the ppm and pH use the procedure used to fix the water reservoir.
    i. If the ppm is too low add equal amounts of both nutrients to the water bath.
    ii. If the ppm is too high remove by draining water from the reservoir and then add fresh water from water source to the initial fill line. And adjust to the new reading.
    iii. If the pH is too low add pH up. If the pH is too high add pH down. It is important when adjusting the pH and nutrient level to add solutions in small amounts. Adjusting in small increments and mixing well gives the most accurate reading.
7. When the water reservoir is fixed, record the target, start, and end readings along with the amount of each solution used. Do this on a daily basis until the 10 to 12 days of Propagation period are complete and the plants are ready to be transplanted. When the plants have grown enough height and strength in their stems they are ready to be transplanted to the next hydroponic growth system, such as the Tower Growth System or the Tube Growth System.

Safety Procedures:

I. When carrying out the daily upkeep of the propagation system, it is essential to keep all equipment clean and sterile at all times. When using the Combo Meter between and after test readings wash with de-ionized water and dispose of the water sample being tested in another source such as the sink. This precaution gives the meter and the water sample the most accurate reading.

II. When adding nutrients to the water reservoir, do not mix the two solutions of nutrients before adding them. Measure and pour them separately in the graduated cylinder when adding them to the water reservoir. Then wash the graduated cylinder for future use.

III. Algae growth may appear if plants are left in the Propagation System for more than two weeks with full lighting. This does not hinder any plant growth; it is a result from the constant light for a long period of time in the system.

IV. If the cubes do accumulate algae and algae run-off spreads in the tray and further in the tubes and back to the water bath, the system needs to be cleaned out after transferring the plants to the next system.

   a. The trays must be cleared of all algae and the water reservoir must be emptied and washed with soap and water.
   b. Use the pump to flush hydrogen peroxide through the pipes to find any excess algae left. Then flush bleach through the system to kill any living bacteria.
   c. Once system is cleaned and flushed out of any excess bacteria or algae the system is ready to fill with water and set to the desired nutrient and pH level for the next batch of seeds.